Compressed Air Magazine

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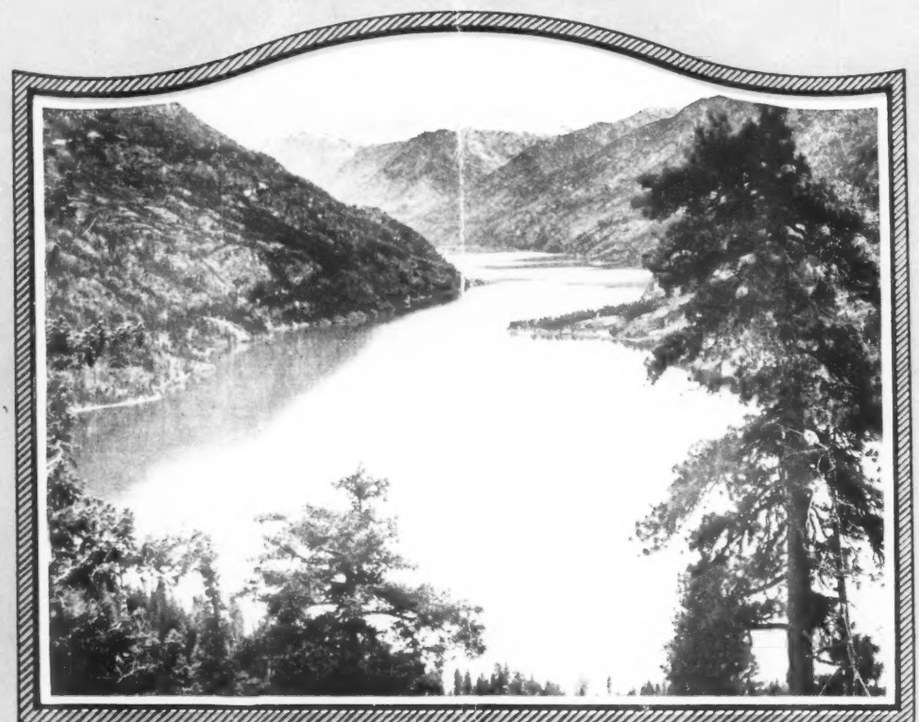


THE LIMPID WATERS OF LAKE CHELAN IN THE STATE OF WASHINGTON ARE NOW PRODUCING A LARGE BLOCK OF HYDRO-ELECTRIC ENERGY

(TABLE OF CONTENTS AND ADVERTISERS INDEX, PAGE 26)

Tunneling Through to China

If it were possible to tunnel through to China, Ingersoll-Rand drills could do it. Since their introduction in 1871, they have drilled through enough solid rock to make several good size tunnels right through the 8000 mile diameter of the earth.

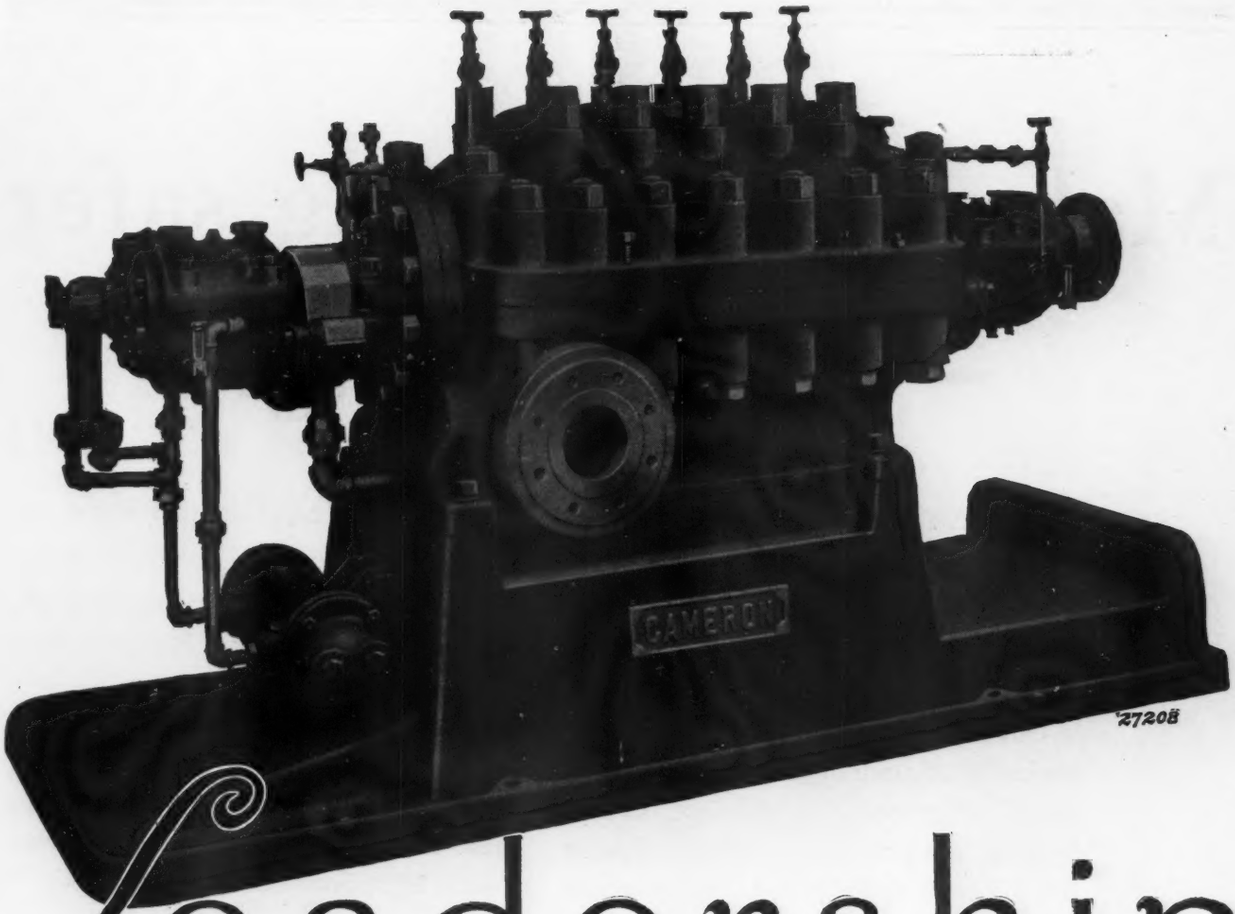
It is difficult to visualize the thousands of miles of shafts, drifts, crosscuts, stopes, and tunnels that these drills have made possible.

The various models of I-R drills have been leaders in their respective fields for 57 years. They are now used in all parts of the world, and there is a size to be had that will meet each drilling condition.

Ask our nearest Branch Office for a copy of our new rock drill bulletin.

INGERSOLL-RAND COMPANY
11 BROADWAY, NEW YORK CITY
Offices in principal cities the world over
For Canada Refer—Canadian Ingersoll-Rand Co., Limited,
10 Phillips Square, Montreal, Quebec.
For Europe Refer—Ingersoll-Rand Co., Limited,
165 Queen Victoria Street, London, E. C. 4

Ingersoll-Rand



Leadership

—more than 50% of the oil pumped through pipe lines by centrifugals is pumped by Camerons

THE centrifugal pump has made it possible to obtain an even greater volume of service from the nation's network of pipe lines. This compact, highly efficient pump will move oil more quickly and economically than the direct-acting type and with less stress on the line.

That Cameron has attained the leadership in this most important branch of the oil industry, is attested by the fact that more than 50% of the oil pumped through pipe lines by centrifugals is pumped by Camerons.

A. S. CAMERON STEAM PUMP WORKS
11 Broadway, New York City

Offices in principal cities the world over

Butte · Birmingham · Chicago · Cleveland · Dallas · Denver · El Paso · Los Angeles · Mexico City
New Orleans · Pittsburgh · San Francisco · St. Louis · Salt Lake City · Tulsa

297-DV

Cameron Pumps

Make metal mining safer — *use more light*

SAFETY engineers and mine operators are continually striving to reduce the number of accidents in metal mines. Safer working conditions underground is a subject of constant study.

Government reports show that the majority of under-ground accidents in metal mines occur at the face, caused by roof falls and the movement of loose ore. Flood lighting can help prevent these accidents by illuminating dangerous conditions before an accident occurs.

The Carbic Flood Light

The Carbic Flood Light is ideally suited for use in metal mines. Experiments carried on during the past year in a large number of these mines in various sections of the country have proved the advantages of the Carbic Flood Light when used in addition to miners' cap lamps for under-ground illumination.

One Carbic Light will brightly illuminate the highest stope. Large boulders on the slope are easily seen and the roof can be carefully inspected. Even in stopes filled with fog, a Carbic Light will adequately illuminate the working area. Miners can work directly facing Carbic light because there is no glare.

Other Uses for the Carbic Light

While the greatest need for the Carbic Light is in the stopes, it is also useful for haulage roads, shaft stations, underground shops and various other places where a self-contained flood light is required. Quarries and strip mines will find the Carbic Light makes night work safer and more productive.

CARBIC

Used for 14 years on the surface

THE Carbic Light has been used on the surface by contractors for more than 14 years. Thousands of Carbic Lights are supplying dependable illumination for night construction work. It is the standard portable flood light.

The Carbic Light is extremely simple. There are only three parts. It can be charged in three minutes. It is truly portable. It can be easily carried from stope to stope. It is absolutely safe. If it is knocked over, the water runs out and the generation of gas stops immediately. The flame will not blow out. The Carbic Light is listed as standard by the Underwriters' Laboratories, Inc. It is economical to operate. Gas is generated only as desired.

If your jobber cannot supply you, write to our nearest district office.

OXWELD ACETYLENE COMPANY
Unit of Union Carbide and Carbon Corporation

New York City
30 East 42d Street

UCC

Chicago
Peoples Gas Building

San Francisco, 8th and Brannan Streets

Cadet Light

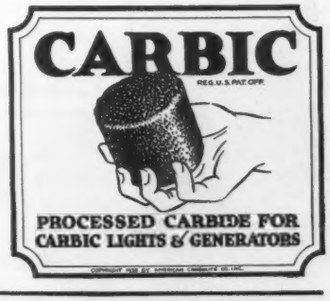
Supplies adequate light for small stopes, roof trimming and shaft stations. Weighs only 16 lbs. empty and 30 lbs. charged. Burns 5 hours on one full charge. The operating cost is 5 cents an hour.

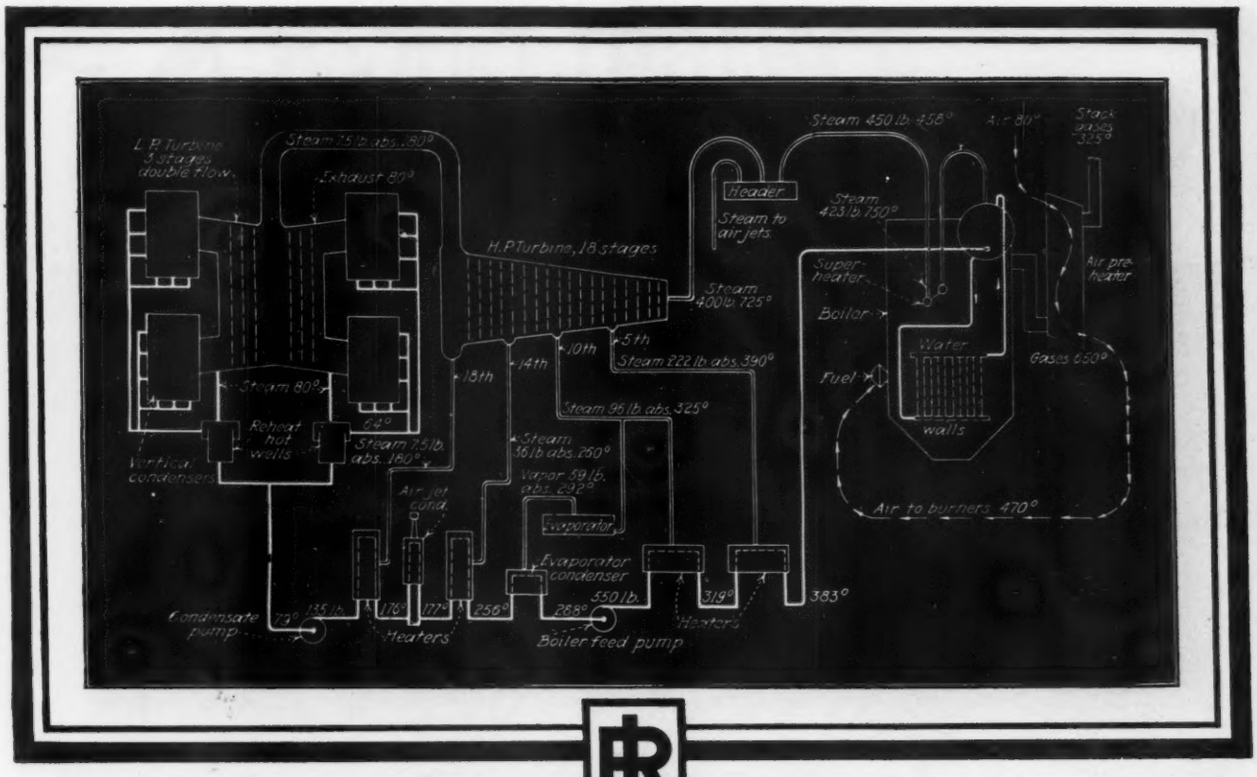
Style No. 2

For illuminating large stopes. Weighs 37 lbs. empty and 115 lbs. charged. One full charge is sufficient for 12 hours of continuous use. Costs 6 cents an hour to operate.

Carbic is distributed by the Union Carbide Sales Company through its national chain of warehouses and is sold by jobbers everywhere.

LIGHT





This is the latest unit in the largest steam plant west of the Rocky Mountains. The plant was designed and built by Stone & Webster, Inc., under the supervision of the Department of Engineering Design of the Southern California Edison Company.

Ingersoll-Rand Condensers and Cameron Pumps were selected for this modern central station

THE above illustration from the January 24th issue of "Power" shows the flow diagram of the new 94,000 kw. generating unit being installed in Plant No. 3 of the Southern California Edison Company. The turbine will be one of the largest in operation.

Of the equipment shown, Ingersoll-Rand furnished four vertical, single-pass surface condensers having a total surface of 80,000 sq. ft.; three Type HW two-stage Cameron Condensate Pumps; one two-stage Steam Jet Vacuum Pump equipment mounted on external air coolers; and four Cameron Type HMT Boiler Feed Pumps. Although not shown in the diagram, the plant also includes two No. 54 FV Cameron Centrifugal Circulating Water Pumps to handle a total of 165,000 gallons per minute, six Type HW two-stage Heater-Drain Pumps, and three Cameron General Service Pumps.

Catalogs, data, and specific information will be gladly furnished to anyone interested in such equipment.

INGERSOLL-RAND COMPANY 11 BROADWAY NEW YORK

A. S. CAMERON STEAM PUMP WORKS

Offices in principal cities the world over

For Canada refer: Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec

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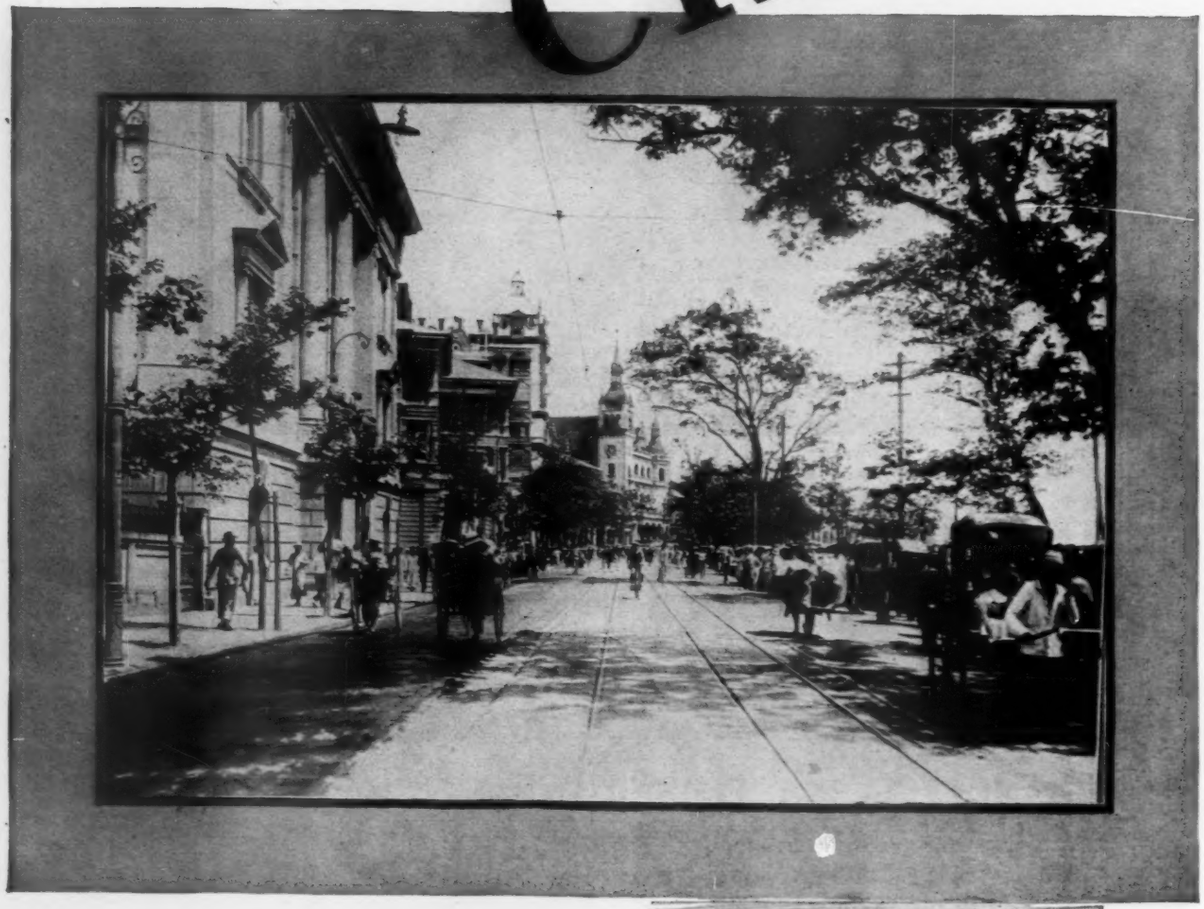
301—DV

Ingersoll-Rand

A. S. Cameron Steam Pump Works

CHINA—



Wherever you go along the main arteries of travel, or in the by-ways, International Combustion makes possible your luxuries and your necessities.

—A world market *of tomorrow*

China, the political mystery of the past year or more with its civil wars, intrigues and plots, has kept the cables busy with news of its shifting happenings and tragic struggles with new forces which are rousing the great sleeping empire to a realization of a new civilization which is pressing at her doors.

China will be a world customer of tomorrow for the best that the West can supply and in this connection it is interesting to note that a subsidiary of International Combustion Engineering Corporation is at the threshold of this development and is already cheapening the production cost of electrical energy in one of the most romantic of the great eastern cities. It makes no difference where on the globe you travel, you find evidence of International Combustion Engineering Corporation linked with the progress of power plant development where it is desired to put the juice on the bus-bar for the lowest possible cost.

International Combustion Engineering Corporation
International Combustion Building
New York City

Why not do welding?

A GOOD mechanic can learn to use an oxy-acetylene blowpipe quickly. And with it he can do many jobs that are profitable.

Why not give yourself or your shop the benefit of this profitable business?

Prest-O-Weld blowpipes are reasonably priced and in addition they are made by the same company that makes the famous Oxweld blowpipes. That means they are good!

Sold by jobbers everywhere.

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Unit of Union Carbide and Carbon Corporation
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NEW YORK CITY
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8th & Brannon Sts.

PREST-O-WELD

Still flying the "Broom!"

"Howdy, Colonell"

"Why hello, Jim! Remember the time you had that BUCYRUS on her side at Dump Six?"—

So begins an article by Edgar Young on the late General George Goethals, in a recent issue of the New York Herald-Tribune.

Fresh is the memory of "the Colonel" in the minds of the thousands of men who toiled with him in building the Canal, and as they think of the wonderful work done by General Goethals and his able assistants, they also recall—as he did—the reliable BUCYRUS machines that saw the job through in the face of innumerable vicissitudes.

Old-timers who worked on the Panama Canal can well remember "The Broom", the emblem that shook its bristles from the proud boom of the shovel holding the output record.

And then can remember, too, how this emblem of victory was carried—from start to finish—by the BUCYRUS machines on the big cut. BUCYRUS won that coveted marker with the highest records for daily weekly and monthly output.

And today, BUCYRUS-ERIES are still proving true to their proud parentage—are still "*flying the broom*" on the world's major construction jobs.

On big railroad projects such as the Canton-Bayard cut-off—where BUCYRUS-ERIES held the output records from start to finish. On the construction of the New Hocking Valley line where more than 60 shovels worked, and again BUCYRUS-ERIES were the yardage leaders from start to finish. On the iron range, in the quarries and coal fields, and on contracting jobs of every size—BUCYRUS-ERIES are "*flying the broom.*"

Having more power to do *harder* work, and do it faster, BUCYRUS-ERIE machines are built with the rugged simplicity that enables them to stand up to the faster pace they set. And as a result, are as widely noted for *Reliability* as for Output.

A Union of Strength

"BUCYRUS" and "ERIE"—each the most successful manufacturer in its particular field—consolidated Jan. 1, 1928. The unmatched resources of BUCYRUS-ERIE assure the buyer of Unequalled Value, More Efficient Machines, Permanence of the Manufacturer, and a More Complete Field Service.

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Representatives throughout the U. S. A. and Canada.
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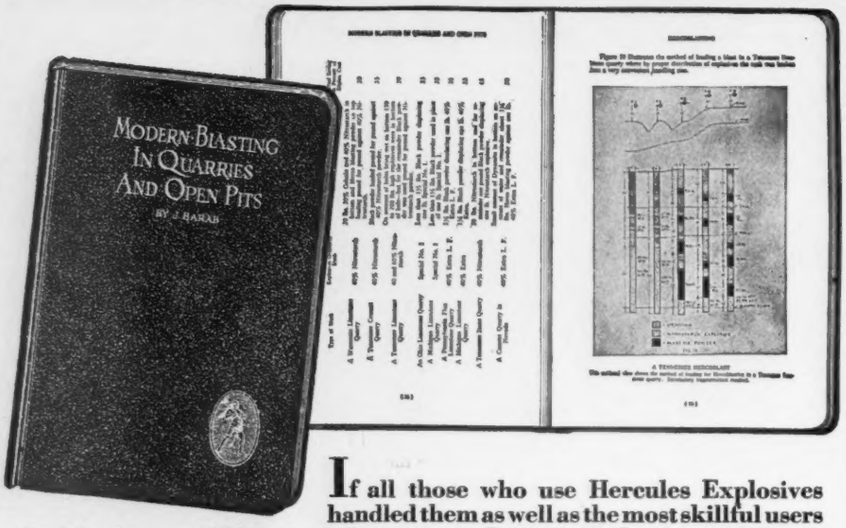
A Book Full of Ideas on Blasting in Quarries and Open Pits



If all those who use Hercules Explosives handled them as well as the most skillful users do, blasting would be carried on more efficiently and economically. A customer who understands scientific blasting is always a satisfied customer.

It is for this reason that the Hercules Powder Company puts special emphasis on that part of its service to customers aimed at making them better blasters. This is why we are constantly issuing booklets designed to acquaint explosive users with the best blasting practice and to inform them of new developments.

"Modern Blasting in Quarries and Open Pits" is our latest contribution to the literature on the technology of blasting. This is a 170-page book illustrated with many photographs and diagrams. It is not a theoretical exposition of the subject, but is based upon field observation of blasting operations in many quarries and open pits. It is divided into twenty-one chapters covering a range of subjects from "Drills and Drilling" to "Keeping Records of Quarry Blasts."

To quarry superintendents and managers of open pit mines this book will prove valuable and interesting. If it only contributes one new idea that idea may save thousands of dollars.

Write us on your business letterhead and secure a free copy of "Modern Blasting in Quarries and Open Pits."

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(INCORPORATED)

Sales Offices: **Allentown, Pa., Birmingham, Buffalo, Chattanooga, Chicago, Denver, Duluth, Hazleton, Pa., Huntington, W. Va., Joplin, Mo., Los Angeles, Louisville, New York City, Norristown, Pa., Pittsburg, Kan., Pittsburgh, Pottsville, Pa., St. Louis, Salt Lake City, San Francisco, Wilkes-Barre, Wilmington, Del.**

Hercules Powder Company, Inc.
932 King Street, Wilmington, Delaware

Please send me information about the new Hercomites, No. 2 to No. 7, that save from 10% to 20% in explosives costs.

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Company _____

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The long reach of the dipper arms and the manner in which the dipper is dumped permits loading into long, high cars. Here the Nordberg-Butler Shovel is loading into a 9 foot car.

A World's Record in Mine Drifting

8'x9' tunnel—5412 feet long

Never before has such a feat been accomplished in a mine tunnel driving job. It is but another evidence of the kind of performance that the Nordberg-Butler Shovel gives.

This record was made in driving the Ojuela drain tunnel, 5412 feet long and 8'x9' in section for the Cia Minera de Penoles at Mapimi, Durango, Mexico, a subsidiary of the American Metals Company. The average monthly advance was 714 feet and the best single days advance was 42 feet. The tunnel was through interbedded limestone and shale and driven at a cost not exceeding $20.00 per foot. This included a complete write-off of all machinery and no credit given for salvage.

Another remarkable feature of this record was that it was made with a crew that had no previous experience with mechanical mucking machines. With the exception of the shaft bosses, the mucking crew was composed entirely of local labor.

Even though the Nordberg-Butler Shovel is considered a small, light weight machine, this record speaks worlds for its design and construction. With the selection of proper materials best suited for their services and the correct proportioning of the various parts, the designers have succeeded in producing a shovel whose performance surpasses that of heavier and much more expensive machines.

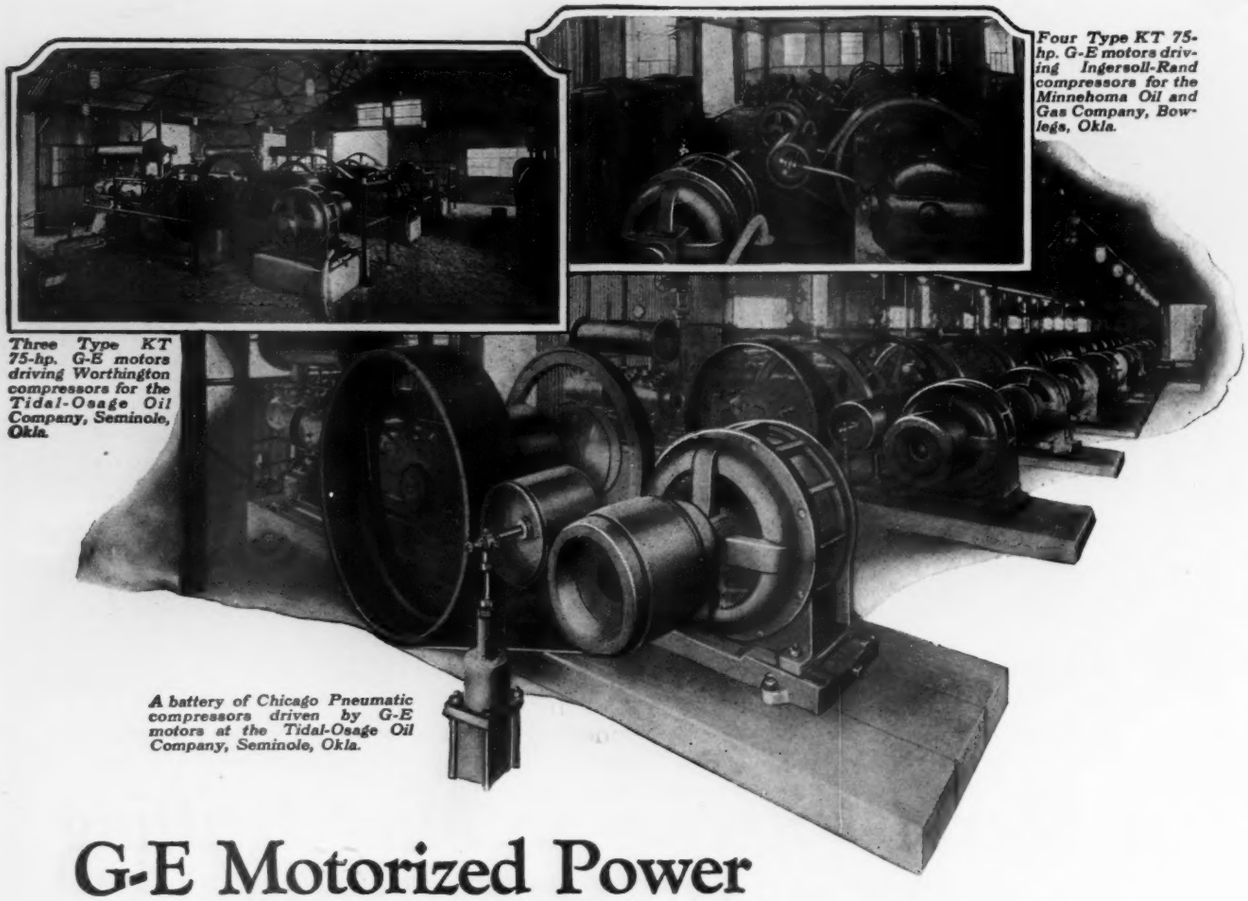
What the Nordberg-Butler Shovel has done on this job, it can do on others where proper methods are used to meet the conditions of mechanical loading. Write our Underground loader Department about your loading problem. Bulletin DR-10 describes this shovel.

Nordberg Mfg. Co., Milwaukee, Wis., U. S. A.

Builders of machinery for the mining industry

NORDBERG-BUTLER SHOVEL

A Low Cost Shovel for Mines and Tunnels



Four Type KT 75-hp. G-E motors driving Ingersoll-Rand compressors for the Minnehoma Oil and Gas Company, Bowlegs, Okla.

Three Type KT 75-hp. G-E motors driving Worthington compressors for the Tidal-Osage Oil Company, Seminole, Okla.

A battery of Chicago Pneumatic compressors driven by G-E motors at the Tidal-Osage Oil Company, Seminole, Okla.

G-E Motorized Power —ideal for air-gas lift

General Electric supplies complete electric equipment to the oil industry. With warehouse facilities close to your operations, G.E. readily furnishes motors, controllers. transformers, arresters and other protective devices, capacitors for power-factor improvement, switching equipment, etc.

G-E oil fieldspecialists at: Dallas, Denver, Houston, Kansas City, Oklahoma City, Tulsa, Los Angeles, San Francisco.

Smaller bulk and less weight make motors and control easier to install; and when one job is done, they are conveniently moved to another. At Seminole, the same G-E motors have been used on as many as five different leases.

Reliability is another of the advantages which make electric power ideally suited to air-gas lift work. Continuous production is assured—when shutdown means hundreds of barrels of oil irrecoverably lost.

G-E Motorized Power has demonstrated its worth in air-gas lift work. Its low first cost, low maintenance, and almost negligible depreciation give it marked advantages over other types of drive. Your nearest G-E office is always ready to supply complete information and other service.

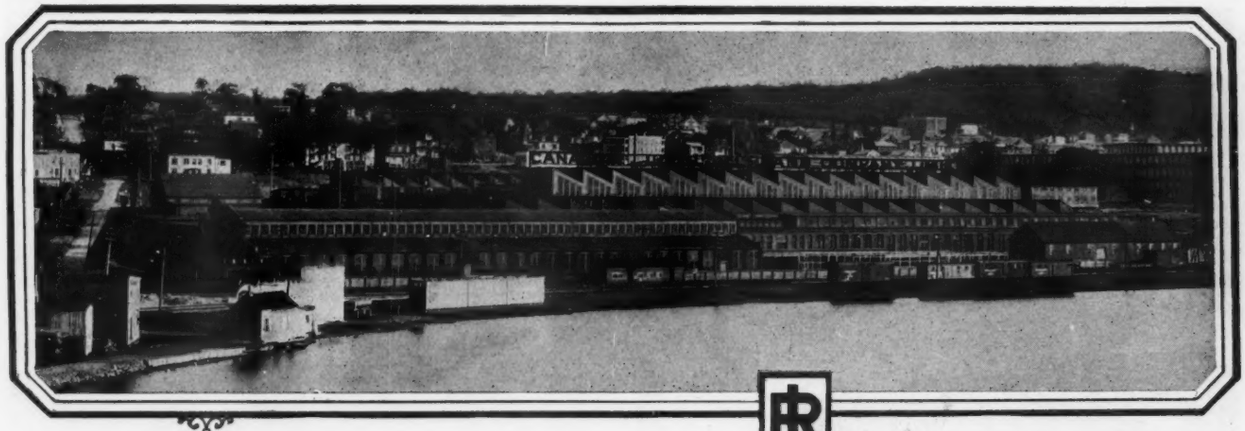
Apply the proper G-E motor and the correct G-E controller to a specific task, following the recommendations of G-E specialists in electric drive, and you have G-E Motorized Power.

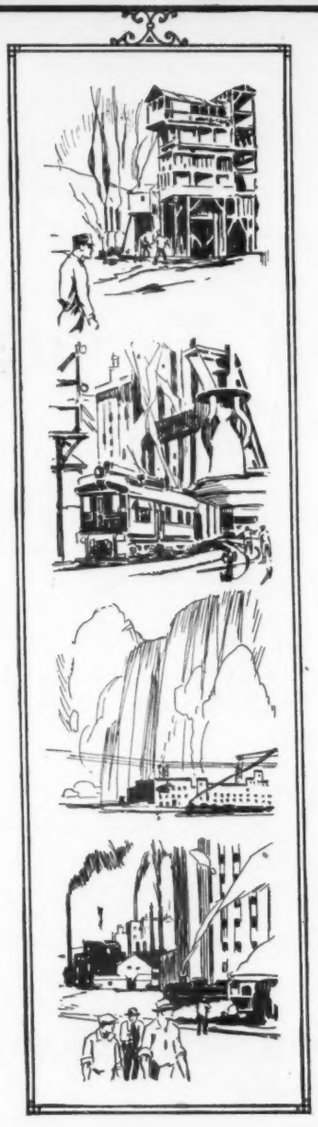
Motorized Power
–fitted to every need

200-151H

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y., SALES OFFICES IN PRINCIPAL CITIES





The Home of Made-in-Canada Compressed Air Machinery

Works of the Canadian Ingersoll-Rand Company Limited, Sherbrooke, Quebec, from the Sherbrooke-Montreal Highway.

SERVING CANADIAN INDUSTRY

FOR thirty-nine years Canadian Ingersoll-Rand products have aided the development of Canada's mines, forests and streams; the construction of her highways, railroads and power plants; and in the building and operation of her factories, shops and mills.

The present works of the Canadian Ingersoll-Rand Company were founded in the year 1899, although old-timers will remember the original manufacture at Sherbrooke and Montreal of "Ingersoll" and "Rand" compressors and drills as far back as 1889.

The products of these works include air and gas compressors; vacuum pumps; rock drills; sharpeners; pneumatic tools; steam and centrifugal pumps; air, steam and electric hoists; rock crushers; rubber, pulp and paper, and other special machinery for Canadian industries.

To assure proper selection, installation and operation of equipment, the company maintains a number of branches from coast to coast. The staff at any of these branches is always ready to render engineering assistance, mechanical service, and prompt deliveries of complete machines and spare parts.

CANADIAN INGERSOLL-RAND COMPANY LIMITED
SYDNEY—SHERBROOKE—MONTREAL—TORONTO—COBALT
TIMMINS—WINNIPEG—NELSON—VANCOUVER
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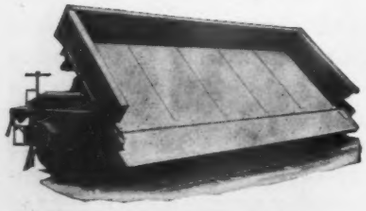
Associate offices in all principal foreign cities

Ingersoll-Rand

Demonstrating Safety and Efficiency at the Orwell Pit of Pickands, Mather & Co.

Complete Safety—Increased Yardage —Lower Costs



The Western Drop Door Dump Car

This was the aim in designing the Western Drop Door Dump Car. Actual service records prove that these ideals have been realized.

This car is of low loading height with single stroke air cylinders and no locks. The load is dumped quickly and thoroughly to either side as desired without changing parts or pins.

A closer inspection will show you the exceptional strength and simple construction that offer you the same economy of operation and increased yardage that present owners of these cars now enjoy.

Bulletin 27-QCM explains this car in detail. Write for a copy today.

Western Wheeled Scraper Company
Aurora, Illinois

WESTERN

DUMP CARS AND GRADING EQUIPMENT

Catches All the DUST

SAND AND GRIT IN DIRTY AIR

Triples Life of Compressors, etc.

The Protectomotor Air Filter removes 99%10% of the dust, grit, sand, and other foreign matter from the air before it enters compressors, engines, blowers, compressed-air tools, etc. That keeps valves free from carbon—reduces carbon deposits 60 to 70%.

As a result 75 to 85% of the wear on moving parts is eliminated. Machines are kept new and more efficient so they will do more work and can be operated from three to five times longer than unprotected machines before overhauling is necessary.

Protectomotor

Sectional View of Model CP Pipe Line Filter

Protectomotor Pipe Line Filter

Pipe lines equipped with the model CP Protectomotor Filter will deliver clean, dry air for paint spraying, compressed-air tools, hoists, cleaning operations, agitating liquids, ice-making, chemical processes, etc.

It removes all water, oil, rust, scale and other foreign matter from air passing through pipes and prevents wear and damage caused thereby to tools and other compressed-air equipment.

The Protectomotor occupies small space. Costs but little to install and nothing to operate. Has no moving parts to wear or get out of order.

Easily cleaned in ten minutes while in operation. Cleaning is necessary only twice a year under ordinary conditions.

Made in sizes to meet every requirement. Over 250,000 Protectomotor Air Filters in use.

FREE Trial Offer

Let us send you a Protectomoter on 30 days' free trial. It it does not do all we claim, return it and the trial won't cost you a cent.

Write for booklet, or simply mail the coupon.

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REG. U. S. PAT. OFF.
Perfect Positive Protection
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STAYNEW FILTER CORP.
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Please send copy of your Booklet on Protectomotor Air Filters.

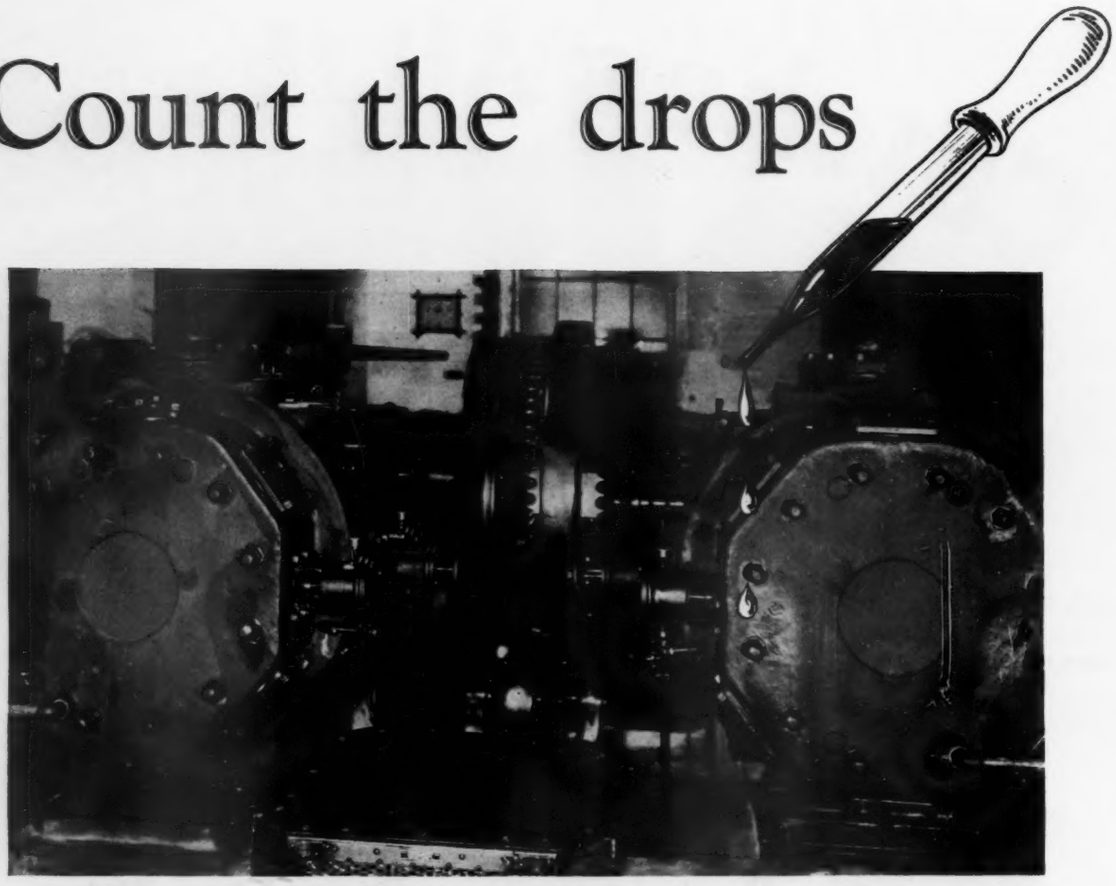
To Use on_____

Name_____

Address_____

Town_____ State_____

Count the drops



DON'T deluge your air compressor with oil. Feed it by drops.

But first of all be sure you have an oil so rich in lubricating qualities that drops will take the place of a deluge.

With Gargoyle D. T. E. Oil Heavy Medium you can "count the drops" and *every drop will count.*

This "minimum feed" oil resists oxidation. It reduces the formation of carbon deposits. It lessens the risk of air-compressor troubles.

This well known air-compressor oil assures efficient operation. Recommended by a majority of the leading air-compressor builders. Used by the majority of air-compressor operators.

Supplies ready for prompt delivery in leading cities.

NOTE: On request we will send you, without obligation, our authoritative treatise: "Air Compressor Lubrication." Write for your copy.

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The World's Quality Oils for Plant Lubrication

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Headquarters: 61 BROADWAY, NEW YORK

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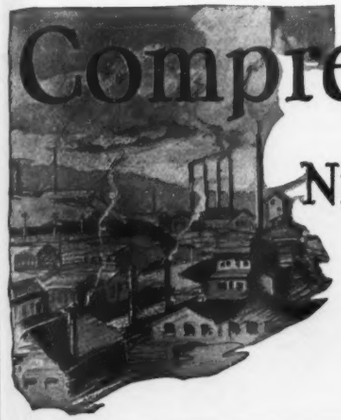


Compressed Air Magazine

NEW YORK · LONDON · PARIS

Principal Offices
Bowling Green Building
No. 11 Broadway
New York.

ol. XXXIII, No. V

MAY, 1928

Current From Waters of Lake Chelan

Hydro-Electric Plant Drawing Energy from That Source Was Recently Completed

By A. S. TAYLOR

LAKE CHELAN, in the State of Washington, is linked with the Columbia River by a precipitous stream that is less than four miles in length. During its brief course, the Chelan River, as the stream is called, drops about 400 feet; and the engineering fraternity looked for years upon the Chelan River as a possible source of a large block of hydro-electric energy. But promising as the physical conditions were, nothing was done to make use of this potential source of power until The Washington Water Power Company was granted permission by the Government, in May of 1926, to go ahead for that purpose.

Today, the power plant, near the mouth of the Chelan River, is actually engaged in producing 32,200 hp. from the waters flowing from Lake Chelan. The work involved in achieving this was done in a remarkably short span of time and in the face of numerous difficulties; and the consummation of the undertaking reflects much credit on every one concerned. Eventually, the present station will be equipped to develop a total of 128,800 hp.

THE Washington Water Power Company has recently put in service its newest nerating station. This plant is now proucing 32,200 hp. from waters flowing from ake Chelan; and when the project is carried its proposed climax, that station will be le to develop 128,800 hp.

Before describing the engineering work ne by The Washington Water Power Comny in this case, it might interest our readers learn something about the primary source the energy that is turning the water wheels the power house situated at a point on the elan River near where the Chelan flows to the Columbia River. Lake Chelan lies the heart of the Cascade Range, at a normal evation of about 400 feet above the Columbia ver; and the outlet of the lake is less than ree miles away, as the crow flies.

The towering mountains, which are not far m the lake, are generally covered with ow in the wintertime, and many of the gher valleys are continually filled with ice. deed, it is mainly from the melting snow and e glaciers that the limpid water comes that s the bowl of the lake, which was gouged t when the ice cap retreated from that gion thousands of years ago. The Great orthern Railway had contemplated develop- power from the waters of the Chelan ver, but had taken no steps to that end. he Washington Water Power Company, wever, believing the time ripe for the utili- tion, purchased the railroad's rights and oceeded with characteristic energy to make e of this source of electric current for the nefit of the public at large.

Lake Chelan extends in a generally north d south direction for a distance of 45 miles, d is a mile wide where broadest. For unld centuries Lake Chelan sent its waters by tumbling, serpentine course through a rocky rge that gave an outlet into the Columbia River at a point about three miles away. Occasional small tunnels or flumes diverted some of the water into irrigating canals—otherwise the stream ran its short and precipitous way without being put to any use. The water drawn off for irrigating purposes has served to vitalize the soil of barren tracts upon which can be grown wonderful crops of apples that have made that part of the state famous for its luscious fruit. It required the enterprise of The Washington Water Power Company to put the energy available to service in generating electricity that could be sent hither and thither to furnish light or motive power for a multiplicity of purposes.

The Washington Water Power Company has, today, eight generating stations that supply electricity to approximately 50,000 customers located in ten counties in eastern Washington and in six counties in northern Idaho. All told, the current is transmitted over nearly 1,300 miles of power lines and then distributed by 1,485 miles of service lines. At the moment, the eight plants have a total installed capacity of 219,500 hp. The construction of the Chelan undertaking was the company's response to a steadily increasing demand for more current; and the Great Northern Railroad will take a block of energy as soon as the electrification of the section east of Wenatchee—about 40 miles away from the Chelan station—is completed.

The Chelan hydro-electric project, as it has been commonly called, consists of three main features: a dam across the valley of the Chelan River and just below the southern outlet of Lake Chelan; a pressure tunnel, having a length of 11,680 feet and a finished internal diameter of 14 feet; and a power house that now contains one vertical unit capable of developing 32,200 hp. Another unit will be installed during the summer of the present year. Later on, a second parallel tunnel will be driven, and more water wheels and generators will be added to the power plant.

© Simmer

Left—A section of Lake Chelan.
Right—Highway bridge over the Chelan River.

Construction work in connection with the Chelan project progressed at a notably rapid rate. Preliminary explorations were begun as recently as January, 1926; and the station was able to deliver power to the line on September 16, 1927. The building of the dam and the power house and the driving of the pressure tunnel were intrusted to Grant Smith & Company, as contractors, who did their work quickly and well. During the most active stage of operations 1,250 men were employed on the job.

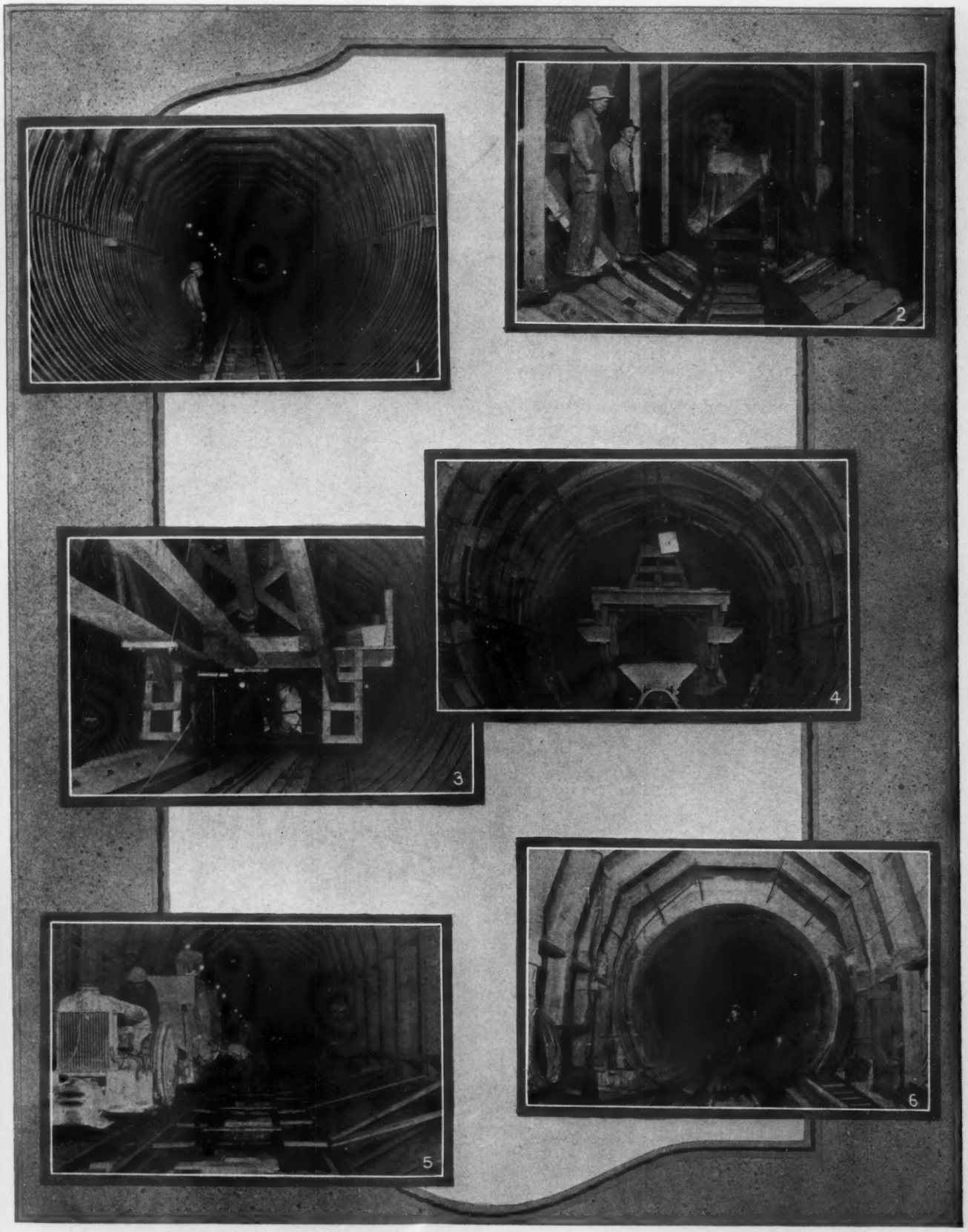
Because of the length of the pressure tunnel, the most difficult part of the entire undertaking, all efforts were primarily centered upon that phase of the big task—work upon the power house and the dam being started subsequently. Permission to proceed was not obtained from the Federal Power Commission until May 8, 1926; and actual construction was not taken in hand much before May 15 of that year. The driving of the main tunnel was commenced on June 1, following; and this had to be preceded by the sinking of two shafts, the driving of two adits, the building of several roads, and the erection of a number of camps.

Tunneling was begun at Shaft No. 1 about 1,600 feet from the northern end of the tunnel line. Shaft No. 2, near the dam, descended to a depth of 35 feet on a sharp incline. From that point on to Shaft No. 1 progress was slowed up because of the nature of the ground, which required timbering and called for the exercise of special precautions to prevent cave-ins.

Although Shaft No. 1 was sunk to a depth of 150 feet and struck a point of rock, still considerable difficult ground was encountered and to provide proper support in this ground the contractor had to resort to timbering that was backed with close-fitted sheathing. All told, it was necessary to timber and to sheathe 2,282 feet of the northern section of the tunnel.

© Simmer

Left—The waters that flow over Rainbow Falls find their way thence to Lake Chelan.
Center—Chelan River seen from Inspiration Point with the Columbia River in the distance.
Right—The deep rocky gorge through which the Chelan River runs its tumbling tortuous course.

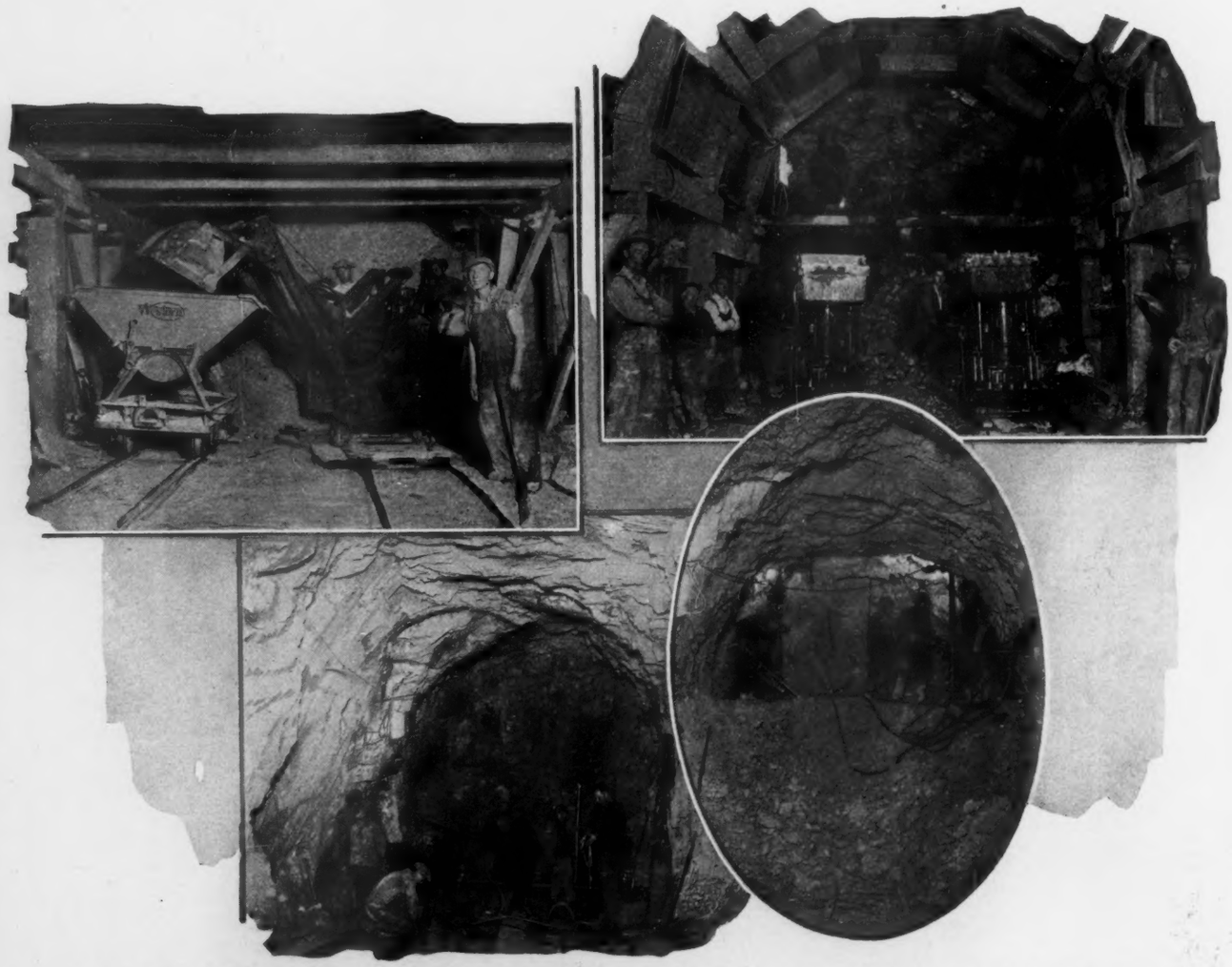


1—Steel reinforcement partly in place in the tunnel.
2—Pouring concrete in the footings of the tunnel lining.
3—Compressed-air-operated concrete gun ready to shoot a charge.
4—Rear end of the concrete-gun jumbo, showing collapsible metal forms in position.
5—Pouring concrete in the invert curb of the tunnel lining.
6—Section of completed concrete lining, showing some reinforcing steel and timbering.

Throughout the timbered stretch, headings were advanced and the tunnel enlarged by methods usually employed in pushing forward through bad ground. Approximately 90 per cent of the length of the tunnel penetrated sound rock of granitic formation in which tunneling was done with top headings, 7x7 feet in cross section. This left a bench just wide enough for the men to work on with two upright bars. The practice was to set up two drills on one bar and only one drill on the other bar. Next, the bench was drilled with four machines on a crossbar—should at no point project within a line 6 inches back from the surface of the finished tunnel—that is to say, no mass of rock having an area of 3 square feet or more should lie within the 6-inch line. An average clearance of 12 inches between the rock and the surface of the concrete was called for.

Except within the long stretch of bad ground, timbering was placed in the tunnel only at a few points, and it was set up there merely to serve as a temporary protection for the men. In the timbered section of the tunnel the work was performed with exceptional care; and the finished appearance of the timbering and the sheathing spoke volumes for the skill of the carpenters and the thoroughness of the supervision. Some of our illustrations make this plain. In unsound ground, both timbering and sheathing were left in position when the reinforced tunnel lining was placed. In the untimbered parts of the tunnel, the surface of the rock was washed free of dust and particles for the purpose of insuring a firm bond between the rock and the concrete lining. Streams of water, made more forceful with jets of compressed air, were used to do the washing.

In placing the reinforced-concrete lining, the two curbs of the invert section were poured first, and, next, followed the adjacent side footings that completed the invert save for the central channel—the bottom of which was poured last. The curbs were poured from Western 2-yard, side-dump cars, running on a track at one side of the tunnel; and the footings were poured from cars traveling on a track in the center of the tunnel. The concrete cars were hauled by gasoline locomotives.

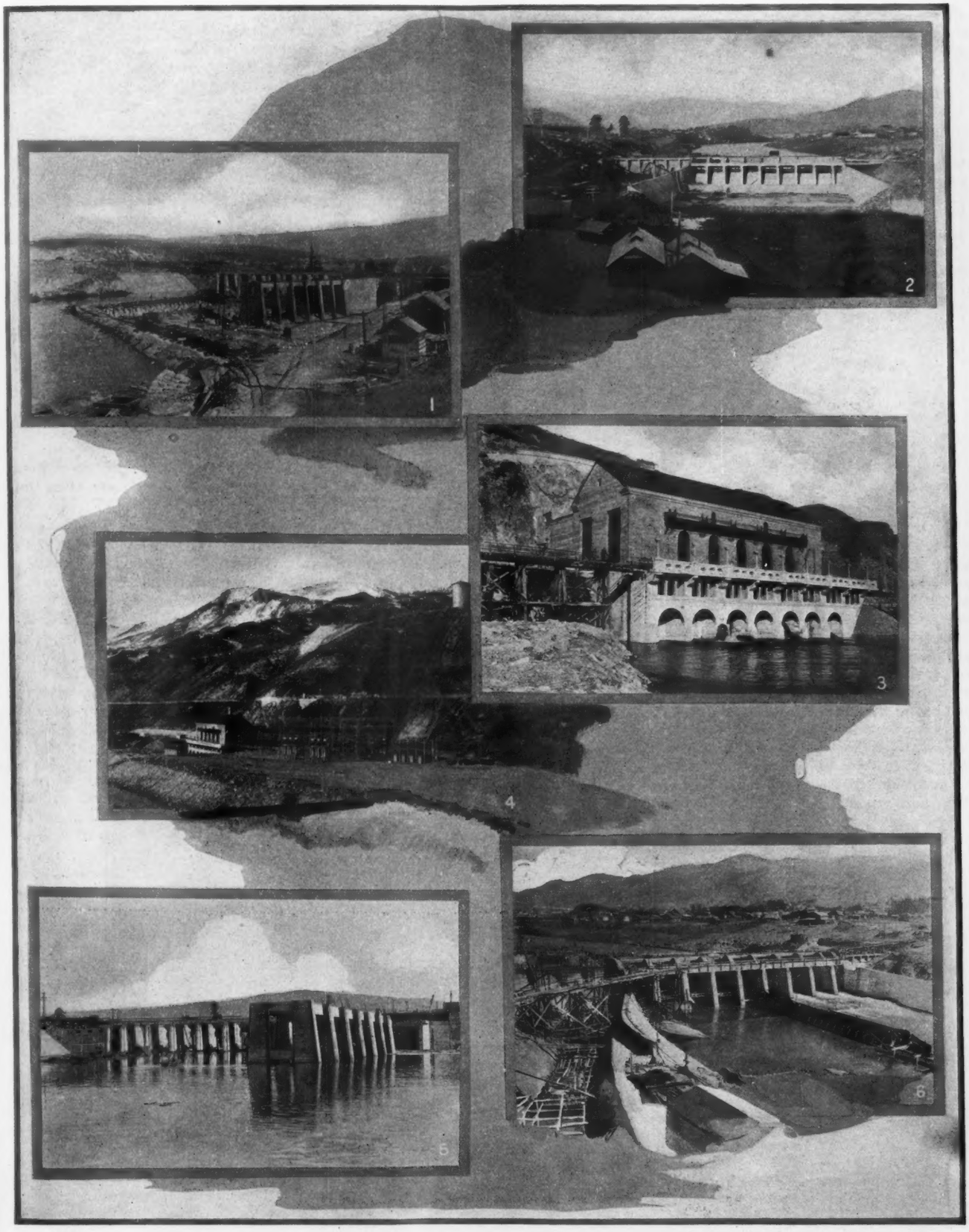


Top, left—Mucking at a heading in unstable ground. Right—Handling muck with two air-driven Butler shovels. Bottom, left—Drilling a bench with drifters mounted on a crossbar. Right—Drilling a top heading with R-72 drifters mounted on upright bars.

R-72's being extensively utilized for this purpose.

After a heading and its associate bench had been drilled, then the whole face was blasted. As soon as the gases of explosion had been dissipated, the drills were set up on top of the muck so as to resume drilling at the heading. A drill round averaged 30 holes, each 8 feet deep. "Jackhamers" were used to drill off high spots on the tunnel sides. The contractor was required to see to it that the rock should be so excavated for the tunnel section that it

In placing the concrete in the sides and the arch, collapsible steel forms were utilized; and the concrete was handled from a jumbo—the loaded cars being pulled up a ramp at the end of the jumbo by an air-operated hoisting engine. The cars dumped into a chute leading to a Ransome gun, which conveyed the concrete through a flexible pipe to openings overhead in the forms. Tunnel sections 50 feet long were poured at a time. The average thickness of the concrete lining—including timber when in place—is about 15 inches.



Courtesy, The Washington Water Power Company.

1—Chelan dam and intake, looking downstream.
2—Completed dam viewed from the downstream side.
3—Power house on the Chelan River near the point where that stream flows into the Columbia River.
4—Power house, switch yard, and surge tank.
5—Intake and dam on Chelan River shortly before the completion of the project.
6—Chelan dam showing the diverted river during the final stages of construction.

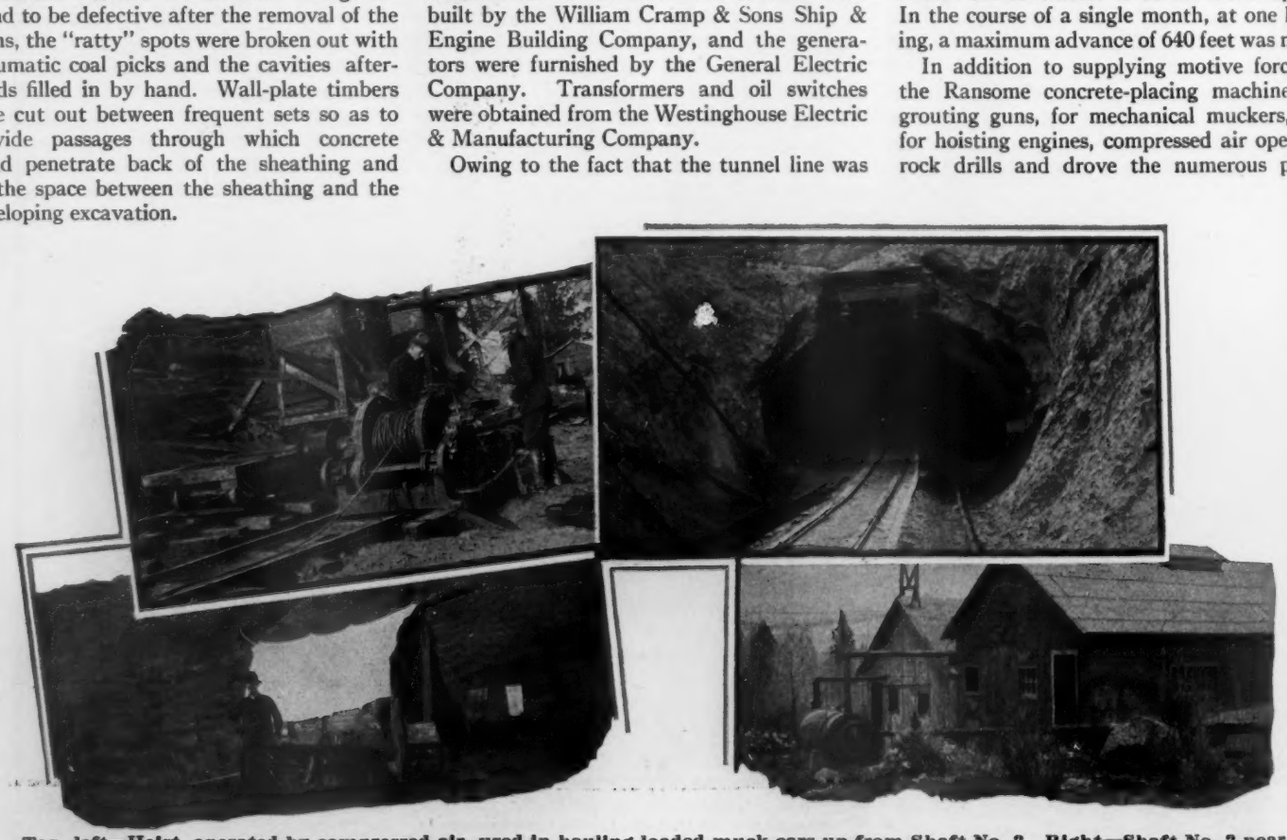
Top, left—Reinforcing steel for the concrete lining of the tunnel. Right—Chelan River during the preliminary stages of construction of the dam.
Bottom, left—Type of side-dump cars used at the surface in handling concrete for the tunnel lining. Right—Constructing the cofferdam by means of which the Chelan River was diverted during the building of the dam.

The compressed air used in operating the Ransome gun had a pressure of 110 pounds. The collapsible steel forms embraced substantially three-fourths of the circumference of the tunnel section—the remaining arc being the invert. Where the concrete lining was found to be defective after the removal of the forms, the "ratty" spots were broken out with pneumatic coal picks and the cavities afterwards filled in by hand. Wall-plate timbers were cut out between frequent sets so as to provide passages through which concrete could penetrate back of the sheathing and fill the space between the sheathing and the enveloping excavation.

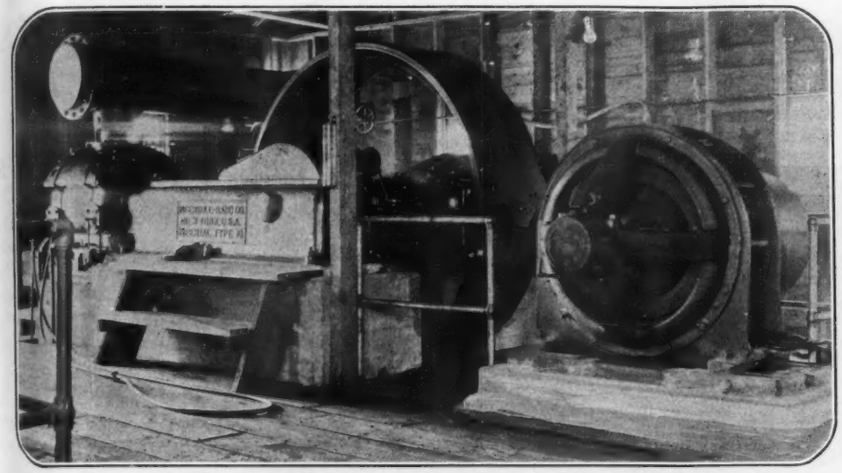
Ninety feet in from its southern outlet, the pressure tunnel is branched and forms two penstock tunnels, each about 8 feet 10 inches in diameter. The steel penstocks are concreted in these tunnels; and each penstock delivers water to its own turbine. The turbines were built by the William Cramp & Sons Ship & Engine Building Company, and the generators were furnished by the General Electric Company. Transformers and oil switches were obtained from the Westinghouse Electric & Manufacturing Company.

Owing to the fact that the tunnel line was intercepted at five points by three shafts and two adits, not to mention the two portals for the penstocks, it was possible to advance headings simultaneously at seven or more positions along the tunnel line; and this permitted the contractor to do the work rapidly. In the course of a single month, at one heading, a maximum advance of 640 feet was made.

In addition to supplying motive force for the Ransome concrete-placing machine, for grouting guns, for mechanical muckers, and for hoisting engines, compressed air operated rock drills and drove the numerous piston



Top, left—Hoist, operated by compressed air, used in hauling loaded muck cars up from Shaft No. 2. Right—Shaft No. 2 near the dam site.
Bottom, left—Habitation of one of the teamsters employed on the Lake Chelan job. Right—Compressor house at the northern end of the undertaking.



One of the several Ingersoll-Rand compressors that furnished air for various purposes on the Lake Chelan project.

pumps that were employed to handle water seeping into the tunnel. Air for these purposes was provided in the main by five XB Ingersoll-Rand compressors, placed at strategic points, and was distributed through 4-inch lines. The air for the drills used in excavating and in clearing away the rock in roadbuilding was furnished by several I-R portable compressors.

The dam, which impounds the water of Lake Chelan, is of reinforced concrete, and has a height of 57 feet from the bottom of the cut-off to the crest. The dam serves to raise the level of the lake 15 feet above normal high water; and a storage of 640,000 acre-feet of water is available from the maximum drawdown. It may be of interest here to mention that soundings have shown Lake Chelan to have a maximum depth of 1,400 feet. When filled level with the spillway of the dam, the effective head at the water wheels in the power house is about 400 feet. Ultimately, when the two tunnels are drawing water from Lake Chelan to drive four turbines, then a total of approximately 4,000 second-feet of water will be diverted to the power house.

The Chelan project has been under the general supervision of Mr. V. H. Greisser, chief engineer of The Washington Water Power Company, assisted by Mr. A. J. Turner, supervising engineer of construction, and Mr. T. H. Judd, resident engineer, also of the power-company organization. The design was developed by the engineering department of The Washington Water Power Company at its Spokane office. Grant Smith & Company was represented by Mr. Harry H. Hunt, vice president; Mr. George R. Putnam, general superintendent; and Mr. V. G. Hindmarsh, tunnel superintendent.

According to statistics of the cement industry, more than 45,000,000 barrels of cement were required for the concrete roads, streets, and alleys built in the United States in 1927. This was 27 per cent of the total amount of cement produced in that period.

It is reported that a new company is being founded in Sweden to exploit the Flodin-Gustafsson method for the direct electric production of forgeable iron and steel and stainless iron and steel.

FLORIDA POST OFFICE HAS COLD-STORAGE PLANT

POST offices, especially those situated in warm climates and handling large quantities of perishable commodities, should take a leaf out of the book of Parcel Post Station A in St. Petersburg, Fla., which is a fashionable winter resort. Through that station pass great quantities of vegetables, fruits, and flowers, particularly during the balmy months when the social season is in full swing. To preserve those products while they are in the keeping of the post office and, incidentally, to prevent the stamps from sticking together, there has been built a special cold-storage room 8 feet wide, 13 feet long, and 7½ feet high.

The refrigerating equipment consists of two electrically driven compressors and four cooling coils. There has also been provided a central water-cooling tank from which drinking water is fed by way of insulated piping to fountains placed throughout the building.

GOLD ORES YIELD TO NEW TREATMENT

A GROUP of California and Nevada mining men are shortly to reopen and to develop gold mines in the Meadow Lake mining district in Nevada County, according to the *Nevada Mining Press*, that were abandoned years ago. The Meadow Lake district was discovered in 1863, and was the scene of much activity during a short period in which the mining of the surface deposits produced a large amount of gold. When the sulphide zone was reached, however, the ore resisted all known methods of treatment, and the camp was deserted.

The present project is one of considerable magnitude, and is arousing much interest principally because of the refractory character of the ore and the failure of former attempts to recover the gold content. This difficulty has now been overcome, so it is reported, through the development of a process known as mercurial cyanidation. It is claimed that this process has been employed with marked success in the treatment of arseno-pyrite and other rebellious ores; and it is now being used in the mill of the North Star in Grass Valley and at other large mines in California and in Colorado.

Tests of ore from the Meadow Lake properties with the mercuric-cyanide process have given satisfactory results. One test report gave head assays $7.65 gold, extraction with four hours' contact 91.9 per cent. and cyanide consumption 0.3 pound per ton of ore. Another report gave head assays $8.27 gold, extraction with two hours' contact 94.8 per cent, and cyanide consumption 0.9 pound per ton of ore.

Pines growing on the rocky shores of Lake Chelan. © Lindsley

Portable Compressor Again Proves Its Adaptability

THE Lindy-Butte Mine is so named for two reasons: The day ore was struck on the property, Col. Charles A. Lindbergh reached Butte on his 22,000-mile trip among the states. Therefore, to commemorate that visit and the making of a promising strike, the mine was very fittingly called the Lindy-Butte. Ore might not have been discovered then had the operators lacked a portable compressor to furnish air for their exploratory rock drills and for a steam hoist for which there was then no steam available.

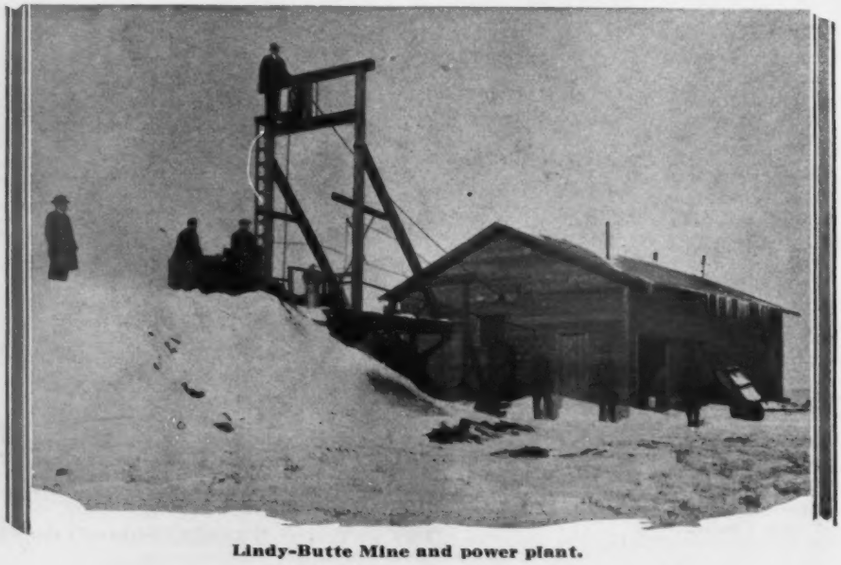
Steam mine hoist that was operated with air supplied by the portable compressor, at the right, until the boiler plant was completed.

As one of the owners of the property expressed it: "I used to think that the finest piece of mining equipment brought out for small mines was the "Little Tugger" hoist; but good as that hoist undoubtedly is it must now take second place when compared with the portable compressor as an indispensable aid in this field of work." The portable is more than a mere labor saver—it is a dependable piece of machinery that alters greatly the problem of exploratory operations.

This praise of the portable was the outcome of the very effective service given by a moderate-sized 7x6-inch Type 20 unit in connection with the Lindy-Butte Mine. The Lindy-Butte is about four miles south of Butte, and lies at an altitude of 6,000 feet. Notwithstanding this altitude, the portable has been called upon to supply air to operate a hoist that handles 1,000 pounds of ore and rock per trip. Not only that, but compressed air from the same source was utilized to drive three BCR-430 "Jackhamers" employed in sinking the shaft. A round consisted of fifteen 5-foot holes that were drilled in one hour—the ground being relatively soft. Of course, the hoist and the drills were not run steadily at the same time; but it was possible, while drilling, to raise or to lower the bucket occasionally.

One of the accompanying illustrations gives an excellent idea of the manner in which the portable was housed, as well as of the size of the hoist operated by means of air furnished by that compressor. It might be of interest to mention that no attendant was assigned to look after the portable: it was only needful now and then to make sure that the machine was properly lubricated. A shift round consisted of one 5-foot sink—including the necessary drilling, blasting, mucking, and placing of a set of timber. This amount of work was accomplished during each 8-hour shift. The gasoline consumption of the portable averaged less than 3 gallons per hour. The capacity of this machine is 160 cubic feet per minute piston displacement.

The purpose in installing the portable was to enable the owners to push forward work on the mine during the time that a steam plant was being erected. The compressor made it possible to carry on the preliminary mining operations without delay; and it continued to supply air for various services until the steam plant was in readiness to take over its part of the load.



Lindy-Butte Mine and power plant.

The Dominion Government is planning to build a national laboratory at an estimated cost of $3,000,000 for the promotion of industrial research.

ENERGY LOSSES REDUCED BY WOODEN RADIO TOWERS

THE use of wood instead of steel for radio transmission towers has proved of decided advantage in preventing loss of energy, in fact has resulted in a saving of 42 per cent of the power developed by the batteries. We are informed by *Export and Import Review* that, upon the completion of the large broadcasting station outside of Munich, Germany, it was discovered that much of the energy produced by the alternators was lost because of the high conductivity of the two 300-foot polygonal steel towers. It was then decided to tear down the masts and to rear wooden ones on the same foundations, but of a height of only 50 feet. This was deemed advisable inasmuch as the wooden construction offered greater resistance to the wind. To increase the weathering quality of the wood used it was first impregnated with creosote. It is claimed that this change from steel to wood has turned out to be highly satisfactory; and there is now available for transmission purposes 62 per cent instead of 20 per cent of the power developed by the batteries.

The United States now has approximately 667,000 miles of improved highways.

Prevention of Compressed Air Illness a Medical Triumph

Cause and Effects of This Ailment are Now Known and Means for Its Treatment Have Been Developed

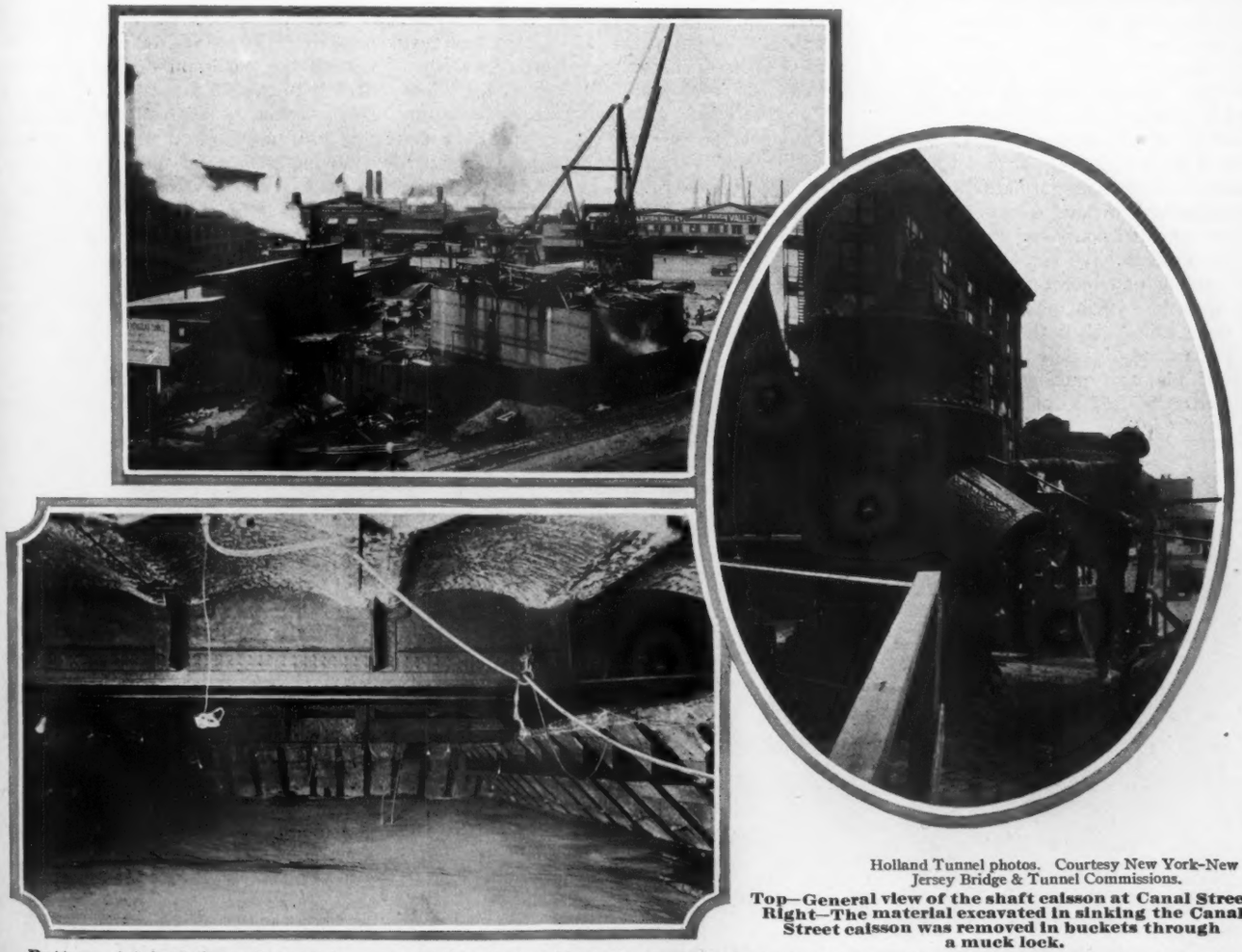
By C. H. VIVIAN

COMPRESSED-AIR illness is a disorder of the body that sometimes affects divers, caisson workers, and other persons who are subjected to air of a higher pressure than normal atmospheric pressure. It is commonly known as the "bends," a term which owes its origin to the fact that the victim frequently experiences sharp pains in the knee joints and instinctively flexes or bends his body at the waist and knees in an effort to secure relief. Another name that has been often applied is caisson disease.

For many years the nature of the ailment was little understood, and numerous erroneous theories of its cause were advanced. But it is now universally agreed that compressed-air illness, as we shall call it, is due to the presence of free nitrogen in the body tissues and fluids. The form that the illness takes depends upon the amount of free nitrogen within the body and upon what tissues are affected. The characteristic symptoms are one or more of the following: localized pains, vertigo, disturbance of the central nervous system, "chokes" or dyspnea, and unconsciousness or collapse.

The heart is a pump that forces the blood through the arteries and the capillaries to all parts of the body, delivering to the tissues the supply of air upon which they feed. This air first enters the lungs, where the blood takes it up to the point of saturation. When the air is inhaled it consists by volume of 79.04 per cent nitrogen, 20.92 per cent oxygen, and .04 per cent carbon dioxide. Most of the oxygen in the blood stream is carried in loose chemical combination with the hæmoglobin, a constituent of the red blood corpuscles. The remainder of the oxygen, together with nitrogen and carbon dioxide also taken up, is in simple solution in the blood.

The air which we exhale is made up of approximately 79 per cent nitrogen, 16 per cent oxygen, and 4.4 per cent carbon dioxide. During circulation, the nitrogen content of the blood remains unchanged, its oxygen percentage decreases almost one-fourth, and its carbon-dioxide percentage increases about 110 times. These alterations in the amounts of oxygen and carbon dioxide are due to the process of oxidation constantly active within the body. In the tissues, the oxygen enters into a form of combustion—its part being much the same as the one it plays in connection with the phenomenon of the open flame,

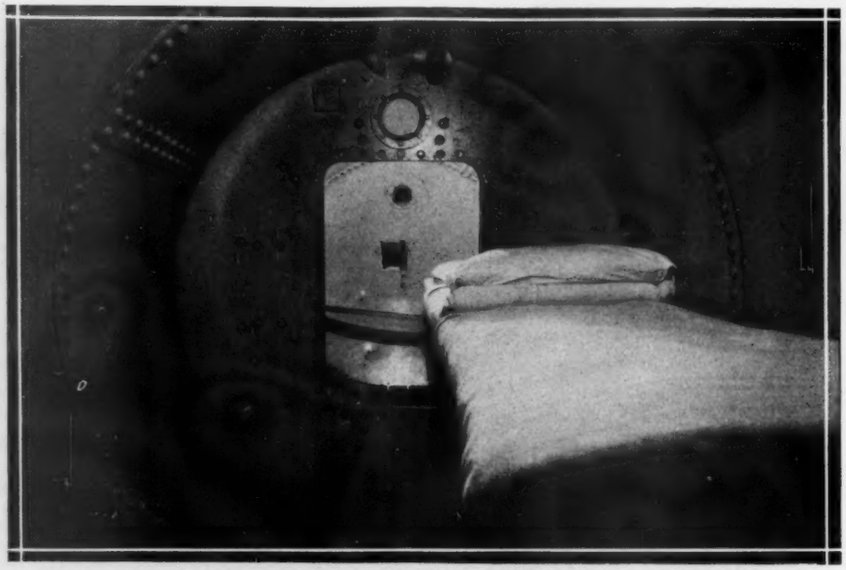


Holland Tunnel photos. Courtesy New York-New Jersey Bridge & Tunnel Commissions.

Top—General view of the shaft caisson at Canal Street. Right—The material excavated in sinking the Canal Street caisson was removed in buckets through a muck lock.

Bottom—A 6-inch floor of concrete was poured in the working chamber of this offshore caisson after it had reached rock bottom.

except that the action is much slower. The product of combustion in both instances is carbon dioxide, which, in the case of the body, is returned to the lungs by the blood. Upon reaching the lungs, it is given off and exhaled along with the oxygen and nitrogen. The inhaled nitrogen, it is well to note, apparently performs no useful function in the body: none of it is assimilated. It is an inert gas that merely enters into solution in the blood, is circulated through the body, and returned to the lungs unchanged and with its original volume undiminished.



Cot in one of the compartments of a medical lock where the pressure worker can rest while undergoing decompression.

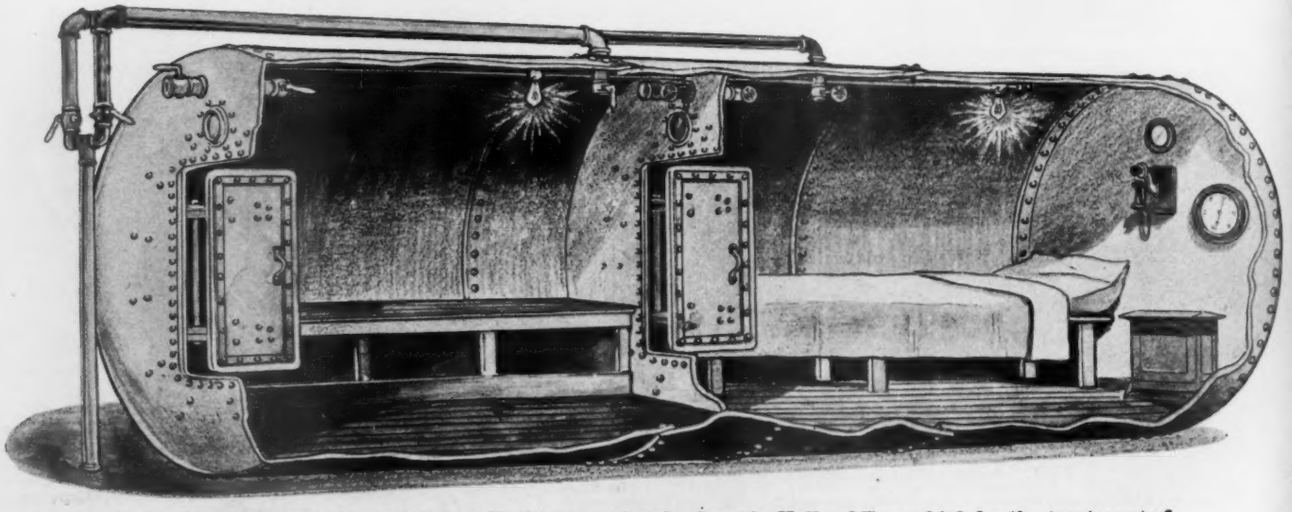
Atmospheric air at sea level has a pressure of 14.7 pounds to the square inch, which, for all practical purposes, can be taken as 15 pounds. If we compress air to 30 pounds gage pressure—which is equivalent to 45 pounds, or 3 atmospheres absolute pressure—we materially decrease its volume. Or, to look at it the other way round, a given quantity of air at 30 pounds gage pressure will expand to several times that volume when the pressure is reduced to that of the atmosphere.

Now let us assume that a diver or a sand hog is at work under 30 pounds of air. This pressure, in itself, does not harm him. Divers have withstood, without injury, air pressures of more than 100 pounds to the square inch. Various animals have survived pressures of 5,000 pounds and more; and we know that some varieties of fish inhabit depths of two and three miles below the ocean's surface. The human body is made up largely of fluids or semifluids; and pressure applied at one point is transmitted to all parts. Thus, the circulation of the worker's blood is not altered in any way.

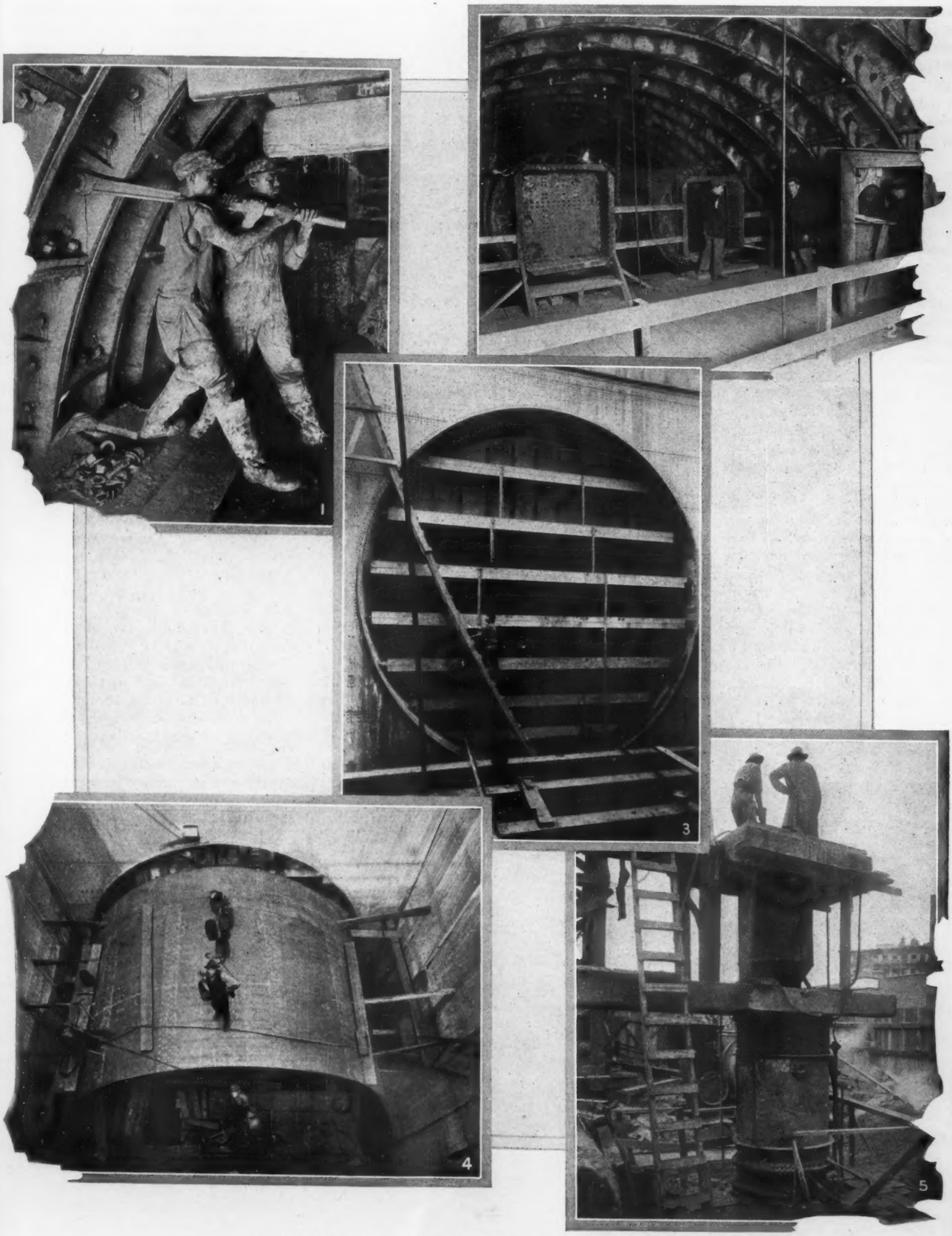
Since the solubility of a gas increases as the pressure increases, the worker's blood, under those conditions, takes up more air from the lungs than it does at atmospheric pressure. In the case of nitrogen, the amount required for saturation is about 1 per cent more for each atmosphere of pressure. When this blood reaches the body tissues, enough of its contained air is given off to bring the saturation of the tissues up to that of the blood. Its air content having been partially discharged, the blood returns to the lungs capable of taking up as much more air as it left in the tissues.

As the blood comprises about one-twentieth of the body and makes a complete circuit each minute, the tissues, theoretically, would be saturated after twenty circuits, or in twenty minutes. However, the body is about one-fifth fat, and this absorbs five times as much nitrogen as does the ordinary body tissue. Therefore, by simple mathematics, it would seem that 35 instead of 20 minutes are necessary for saturation. In fact, it takes longer, because all parts of the body do not receive an equal blood supply, and because the blood returns to the lungs after each circuit with a saturation equal to that of the tissues, thus taking up a smaller amount of nitrogen each time. As nearly as can be ascertained, half-saturation requires 25 minutes and complete saturation 90 minutes. As physical exertion speeds up the blood circulation, the work which the man does tends to shorten the period needed for saturation. We have seen that some of the oxygen in the tissues enters into oxidation or slow combustion and forms carbon dioxide, which is returned to the blood. The nitrogen, being inert, merely enters the tissues and remains there.

When the worker has been subjected to a pressure of 30 pounds long enough to be saturated, the condition of his body may be likened to that of a bottle of charged water. Bringing him suddenly from abnormal pressure to atmospheric pressure is analogous to removing the cap or cork from the bottle. In the case of the water, we know that there is an effervescence, which is caused by the expansion of the dissolved gas into bubbles and their surge to the surface of the liquid. Similarly, the nitrogen in the blood and the body tissues forms bubbles when the pressure is decreased; but as they are trapped in the body they cannot rush to the outer air. The result is that they tend to block the way and to interfere with the normal body functions.



General arrangement of one of the medical locks maintained on the Holland Tunnel job for the treatment of cases of compressed-air illness.



1—Tightening the bolts that bind together the tunnel sections.
2—Sand hogs in a man lock in the south tunnel checking in preparatory to going on a shift.
3—Tunnel opening as seen from the bottom of the Spring Street caisson, on the New York side.
4—The Canal Street shaft, on the New York side, as it appeared from an adjacent building.
5—Lowering concrete through an air lock during the placing of the invert in the Spring Street caisson.

In some instances they exert pressure sufficient to rend or to tear tissues. Obviously, great pain is caused; and if the bubbles reach vital spots permanent injury or death may result.

If, however, the pressure is reduced by degrees, the nitrogen is discharged from the tissues without doing harm and in a manner just the reverse of that in which it entered them. With each circuit of the blood the tissues give up a little of their gaseous charge to the blood which, in turn, is desaturated in the lungs. As the pressure is progressively lowered, this process continues until all the nitrogen above that normally assimilated at atmospheric pressure has been released.

This method of decompression is practiced wherever operations are carried on under compressed air. A diver decompresses himself by ascending a few feet at a time. As the external water pressure on his body is reduced, he equalizes the pressure of the air he is breathing by manipulating his air control. In caisson work, special locks are interposed between the working locks and the open air, and in these the pressure is gradually reduced. This process of decompression is familiarly termed "locking out."

Since the saturation point for nitrogen rises as the pressure rises, it follows that the time required for proper decompression depends upon the pressure to which the man has been subjected. During the first few minutes of decompression the pressure is allowed to fall fairly fast, but after that it is reduced more slowly. It is the practice in both the British and the American navies to make an initial drop of half the absolute pressure, and then to follow this up with less marked reductions. To illustrate: If a diver is working at a depth of 70 feet, he is subjected to a water pressure of 30 pounds to the square inch. This, together with the weight of the atmospheric column, gives an absolute pressure of 45 pounds. During decompression he ascends within a few minutes to a depth where the absolute pressure is 22½ pounds, or about 18 feet below the surface. He then completes the journey in slow stages, moving a foot or two at a time. In caisson operations, the initial drop commonly constitutes half the gage pressure, which, in the aforementioned case, would be 15 pounds gage pressure, or an absolute pressure of 30 pounds. Since the rate and the completeness of decompression are influenced by the rate at which the blood circulates, the workers are encouraged to stimulate the flow of blood by moving their arms and legs while undergoing the transition from high pressure to normal pressure.

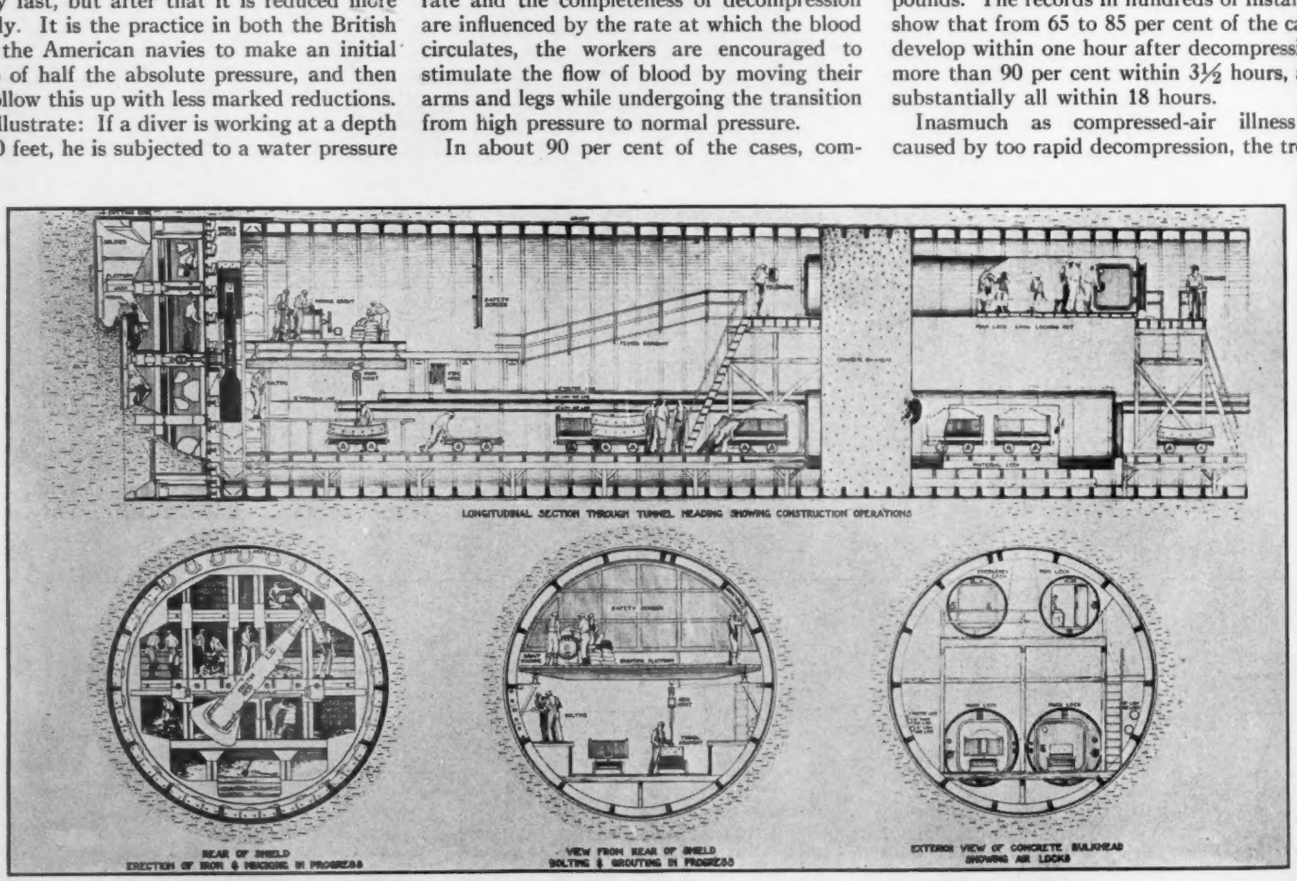
Facsimile of the badge that all pressure workers on the Holland Tunnel were required to wear for their own protection.

In about 90 per cent of the cases, compressed-air illness manifests itself in the form of localized pains. Since certain joints, such as those at the knees and the elbows, receive less blood than any of the other parts of the body, they are most frequently affected—the reason being that it takes longer for them to be decompressed. Conversely, organs like the liver and the spleen, which are richly supplied with blood, are seldom affected.

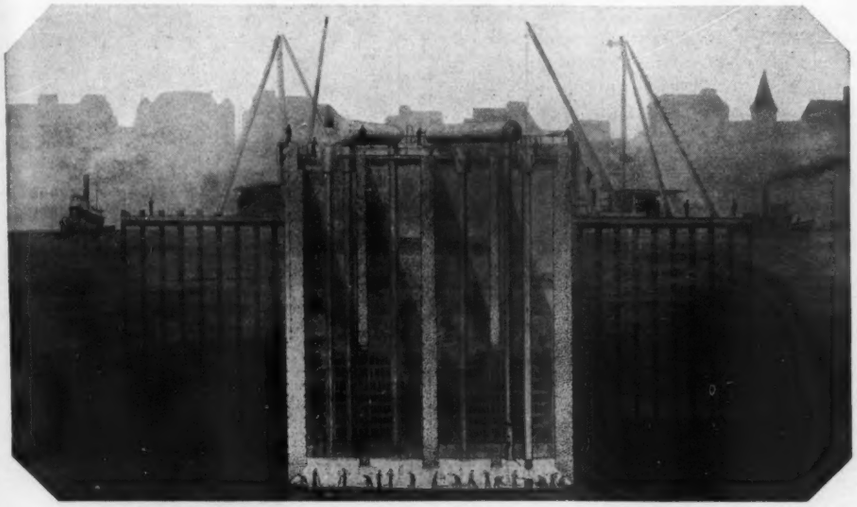
Vertigo or staggers is the outward symptom in about 5 per cent of the cases. Gas bubbles in the middle ear produce dizziness; and the victim lurches about like a drunken man. In the past, sufferers have occasionally been mistaken for inebriates and dealt with accordingly. To obviate such mistakes and to insure their getting proper treatment without delay, compressed-air workers now wear badges which identify them and give the location of a medical lock to which the wearer is to be taken when ill.

The central nervous system is involved in about 1½ per cent of the cases. The cause, in that event, is pressure of the bubbles upon the spinal cord or the brain. Loss of speech, or paralysis of a single part of the body or of the entire lower half of the body may result. In dyspnea, or chokes, the patient experiences difficulty in breathing owing to the presence of bubbles in the pulmonary circulation. Where bubbles of air occur in the blood circulation generally, collapse may follow. This symptom usually exhibits itself only among men working in pressures higher than 35 pounds. The records in hundreds of instances show that from 65 to 85 per cent of the cases develop within one hour after decompression, more than 90 per cent within 3½ hours, and substantially all within 18 hours.

Inasmuch as compressed-air illness is caused by too rapid decompression, the treat-



Sketches illustrating the way in which various subaqueous tunneling operations were carried on in driving the Holland twin tubes.



Cross section of caisson forming the foundation for one of the offshore ventilating shafts of the Holland Tunnel. The working chamber, at the bottom, is resting on rock.

ment consists, first, of recompressing the patient to the pressure under which he was toiling, and then decompressing him slowly and carefully so that the surplus nitrogen will be eliminated from his system. This is done in medical locks, which are maintained at the points of work. Such a lock consists of a horizontal steel cylinder with a door at one end. The interior is divided into two compartments of equal size—the inner one containing a cot and other equipment for the comfort of the person undergoing treatment. The physician in charge may regulate the air pressure from the outside. Heavy-glass windows enable him to watch the patient; and a telephone is provided to permit communication.

Comparatively few physicians are familiar with compressed-air illness; and a great deal of research remains to be done. Notable strides have been made, however, in reducing the number of cases by controlling the conditions under which the men labor. Valuable information was obtained through the work of a committee appointed by the British Admiralty in 1905 to report upon deep-water diving. This was supplemented by investigations carried on by Dr. T. S. Haldane, Dr. A. E. Boycott, and Lieutenant Damant, of the Royal Navy, at the Lister Institute of Preventive Medicine.

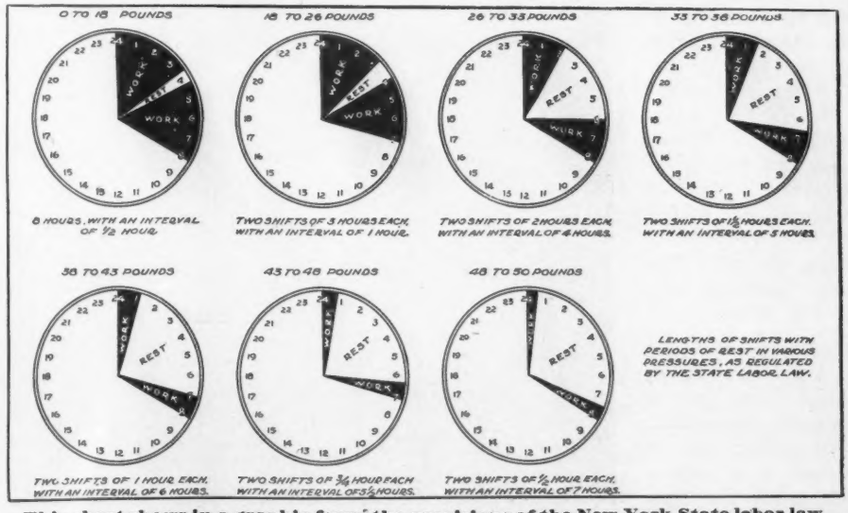
In the United States, a great amount of compressed-air work has been done in recent years, particularly in driving transportation tunnels under the waterways bounding Manhattan Island. As physician to the Board of Transportation of New York City for a number of years and, more recently, as consulting physician to the New York and New Jersey commissions in charge of driving the Holland Tunnel under the Hudson River, Dr. Edward Levy has made an exhaustive study of the subject. His work has contributed materially to the progress that has been made. Among his writings on the topic is a technical paper which he prepared in 1922 for the United States Bureau of Mines, for which he is a consulting physiologist.

Just what has been done to cut down the number of cases and to alleviate those that do occur is apparent from the following data: During the sinking of a mine shaft at Strepy-Braquenier, France, in 1840, all but one of the 134 workmen were stricken. In 1870, in excavating for piers for a bridge over the Mississippi River at St. Louis, 129 cases were recorded. Of these 56 came under the head of paralysis, and 14 resulted in deaths. The driving of the first tube under the Hudson River, in 1885, cost the lives of 9 men, or an average of one per month for every 50 employed. From 1903 to 1909, during the construction of the four Pennsylvania Railroad tunnels that connect New York with Brooklyn by way of the East River, there were 20 deaths and 3,692 cases of illness. The number of decompressions was 557,000, and the ratio of cases to decompressions was 1 to 150. A vast improvement in this respect was noted when the eight other bores were driven under the East River between 1914 and 1921. Out of a total of 1,361,461 decompressions, only 680 required medical attention—the ratio being 1 to 2,000, and of those cases but two proved fatal. The new Holland Tunnel—consisting of twin tubes—was completed without a single death directly attributable to compressed-air illness. During the five years the work was underway there were 528 cases in 756,565 decompressions—a ratio of 1 to 1,433. This tells the story of progress made in treating the disease.

The three factors that most affect the number of cases of compressed-air illness are: Duration of exposure to pressure; height of pressure; and length of time and manner of decompression. The first and the third can be controlled, but the second is determined by the depth at which the work is carried on.

Three states—New York, Pennsylvania, and New Jersey—now have laws that regulate all phases of compressed-air operations, specific reference being made to the hours of permissible labor under various pressures and to the manner and the time of decompression. These laws are administered under the direction of the state labor departments; and they require that there be adequate medical personnel and facilities on all caisson work where the pressure is such as to justify precautionary measures to safeguard the health of the sand hogs.

One of the accompanying illustrations graphically portrays the length of shifts and the periods of rest prescribed under the New York labor law for workers subjected to different pressures. Inasmuch as ill effects seldom result from exposure to gage pressures up to 18 pounds, the law allows men to work a shift consisting of two 4-hour periods divided by a half-hour of rest. As the pressure is increased the working time is cut down and the period of rest lengthened. It will be noted that men under 48 to 50 pounds pressure spend only one hour of their 8-hour shift on the job—toiling half an hour before and after seven hours of rest. In short, it is necessary to employ eight men to perform the same amount of labor that one man can accomplish under normal pressure. Because of these restrictions, compressed-air work at high pressure



This chart shows in a graphic form the provisions of the New York State labor law governing the hours of labor and rest for sand hogs working under different pressures.

is exceedingly costly; and there is an economic limit to its use.

The time required for decompressing or locking out varies in accordance with the working pressure. The New York law permits the initial drop of half the gage pressure to be made at a rate of 5 pounds per minute. The subsequent reductions are made at a rate of from 1 pound a minute to 3 pounds a minute, depending upon the initial pressure.

It is the universal practice now to hire as compressed-air workers only men who can pass a satisfactory physical examination, and also to re-examine all workers at periodical intervals to insure their continued fitness for the employment. Owing to the fact that fatty tissue takes up more nitrogen than normal tissue, the prevailing belief has been that men inclined towards fatness should be excluded. Since increasing age brings a tendency towards obesity, it has likewise been concluded that only men of comparative youth should be considered. Doctor Levy, for one, no longer holds these views; and he cites records from work on the East River tunnels to sustain his position. These records disclose that of the 87 men employed who were over 50 years of age but three suffered from attacks of compressed-air illness.

HAVE YOUR HEATING PLANT VACUUM CLEANED

IN mild weather prepare for winter—get the furnace shipshape before the cold weather comes. A nasty, sooty, messy job? No, it used to be. Today, the cleaning of the heating plant can be one of the easiest and tidiest tasks on the housewife's program, provided she be abreast of the times and have her furnace vacuum cleaned. It is all very simple.

You telephone the cleaner—usually, a leading stove-and-furnace concern in town. If you live in the suburbs, you will in all probability be advised when he expects to be in your neighborhood, as he can do the work for less if he does not have to make an extra trip for the purpose. In other words, he may do Mrs. Smith's on Friday morning, Mrs. Jones' on Friday afternoon and come to you bright and early on Saturday—having parked his equipment somewhere near by. All that is asked of you is the key to the cellar door and permission to put the necessary tubes through the most convenient basement window.

At the appointed time a truck arrives, and from it is led down into the cellar a long canvas tube. At the furnace end of this tube is a suction device much like that on any vacuum cleaner except that it is larger and much stronger in its action. Mounted on the truck is a vacuum pump, operated by the vehicle's engine, that creates a powerful suction. Just as the household vacuum sweeper withdraws dirt from a rug, so does this apparatus suck all the soot, dust, and dirt out of the heating plant. The soot from the furnace passes on to a huge bag outdoors. As the work proceeds, this bag grows steadily larger until it looks not unlike the gas bag of a small dirigible.

Even the most modest vacuum cleaner, when in action, has a way of making its presence known. In the case of the furnace cleaner, the drone is in proportion to its size and, in a quiet neighborhood, may be heard blocks away. This unusual sound, so the furnace cleaner has found, is to his advantage, because it attracts the curious-minded to the scene of activities and often leads to additional business.

Here we see how a vacuum pump, mounted on a truck, withdraws soot and dust from a furnace in making it ready for winter service. The distended bag receives the grimy materials removed from the furnace and the flue.

NEW HIGH-SPEED PRESS IS AIR OPERATED

A HIGH-speed pneumatic press has been put on the market by the Hanna Engineering Works, of Chicago, Ill., that is designed to do all sorts of work calling for coining, squeezing, forming, upsetting, shallow-drawing, extrusion, and punching.

In this machine, an air-cylinder piston unit actuates a ram through the medium of the Hanna toggle-and-lever mechanism, as commonly applied to compression riveters. The toggles close the gap between the dies with little air consumption, while the lever exerts a uniform tonnage on the dies through a considerable portion of the ram stroke regardless of any change in the thickness of the work. By adjusting a hand wheel, at the base of the press, the stroke of the die or ram may be set for a wide range of lengths. The tonnage exerted between the dies is controlled by a pilot-valve regulating spring, and may range all the way from the full press rating down to 20 per cent of that rating. Any pressure between those limits—and the pressure is registered on a gage visible to the operator—can be brought to bear even if the work vary in thickness.

This high-speed press is operated with air at 100 pounds pressure.

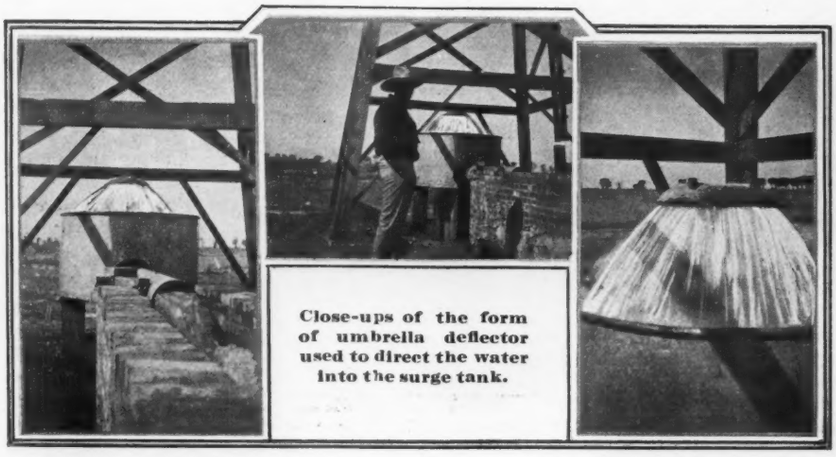
The manufacturer claims that the machine's high speed of from 30 to 40 cycles per minute is attributable to the following outstanding features: Shock-absorbing cushions at both extremes of the piston stroke; air counterbalance; and automatic reverse from down stroke to up stroke. Besides, the foot trip pedal for starting each stroke cycle requires but a 1-inch movement of the operator's heel while he is standing naturally with his full weight on both feet; and only one die-stroke cycle results from each depression even if the pedal—which is safeguarded against accidental depression—be held down. An adjustment provides for ample light between dies to facilitate die setting and to obviate the use of all shims less than ¼ inch thick. This, together with the stroke adjustment, makes for low air consumption—the return stroke being accomplished with less than one-tenth the volume of air required for the full-tonnage working stroke. The press shown in the accompanying photograph exerts a pressure of 150 tons between dies with air at 100 pounds pressure.

United States exports of fresh fruit in 1927 had a total value of $60,000,000, representing an increase of $7,000,000 over the exports for the preceding year.

Needful Water For Mexican Cotton Fields Pumped With Air Lifts

By G. H. DELANO

AT Estación Chavez, Coahuila, Mexico, Mr. Antonio Montemayor has a cotton farm, known as Nuevo Linares. The soil and the climatic conditions are extremely favorable there to the cultivation of the staple—the one drawback being a lack of sufficient rain during the growing season to provide all the moisture needed for abundant and profitable crops. Therefore, it is essential that man make good this deficiency by tapping underground sources of water, and then by raising the water to the surface so that it can be distributed through irrigating ditches to the planted fields.



Close-ups of the form of umbrella deflector used to direct the water into the surge tank.

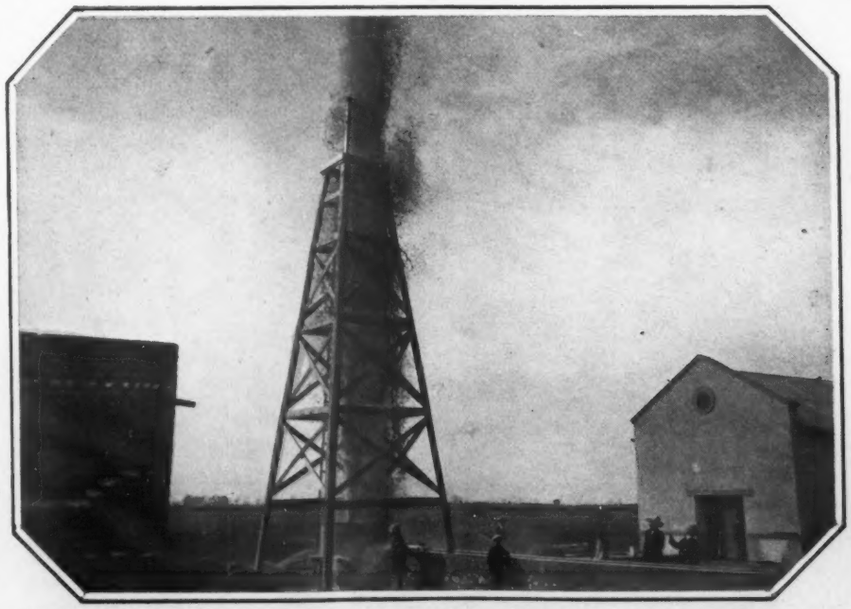
Nuevo Linares has 4½ *lotes* of cotton land, a *lote* being the equivalent of 225 acres. Accordingly, the area given over to cotton aggregates about 1,012 acres—a decidedly sizable plantation. The water for this purpose is obtained from three wells, and is withdrawn continuously, 24 hours a day, for an average of eight months annually. The wells were drilled by James F. Martin Company, of Torreón, Coahuila, who have had wide experience in drilling both oil and water wells.

The wells are 450 feet deep and cased all the way down with 16-inch perforated casing, which is surrounded by a gravel ring 6 inches thick. The subsoil formation consists mainly of fine sand, coarse sand, gravel, and mud, in alternate layers. The wells are approximately 1,970 feet apart and so disposed that they enclose an area having the form of an equilateral triangle.

The subsoil water in this district of Mexico carries a good deal of very fine sand in suspension, and this sand causes destructive wear on centrifugal pumps, when such are used. To be effective, vertical deep-well pumps are usually located about 80 feet below the ground surface, and this permits the wells to accumulate considerable sand which gradually obstructs the entrance of the water into the wells and, thereby, diminishes their capacity. Such being the physical conditions, air lifts are preferable to deep-well pumps; and it is with air lifts that Mr. Montemayor pumps the water for his cotton fields.

The air-lift piping in each of the three wells is made up of 275 feet of 8-inch, 9-inch, and 10-inch tapered discharge pipe, with a 2-inch outside air line. The outlet is 6 feet above the ground surface—the water being discharged, by means of an umbrella deflector, into a small surge tank 5 feet in diameter by 3 feet high. The water then flows by gravity from the surge tank directly into an irrigating canal.

The static level in each well is 17 feet, the drawdown is 21 feet, and the lift is 38 feet. Each well has an average capacity of 34.34 gallons a second when all three wells are pumped at the same time. To emphasize the difference between the operation of a deep-well centrifugal pump and an air lift for the same service, it should be pointed out that when a well with a centrifugal pump becomes obstructed with fine sand it is necessary to remove the pump and to bail out the sand. A week's work is required to get rid of the sand; and this commonly has to be done about once a year. With an air-lift system, such as is installed at Nuevo Linares, there is no need for repairs and no maintenance expense is involved in the case of the equipment within the well. Owing to the fact that the footpiece of the air lift is located 275 feet below the surface, this helps to keep the well clean and to prevent any accumulation of sand above the footpiece. Should it ever become necessary to bail out sand from the bottom of the well, it would be entirely practicable to introduce the bailer by lowering it inside the air-lift discharge pipe; and this can be done without removing any of the piping or connections from the well.



Air lift on one of the wells operating at excess pressure and before the discharge was equipped with an umbrella deflector to direct the water into the surrounding surge tank.

The primary source of compressed air at Estacion Chavez is an Ingersoll-Rand oil-engine unit of 150 hp. This POC-2 unit was erected about 30 feet away from the middle well; and, as the subsoil beneath the compressor was unstable sand, a special foundation 9 inches higher than usual was constructed for it. This foundation rests on a reinforced-concrete platform 18 inches thick, which extends about 6 feet on all four sides beyond the oil-engine compressor.

This view of the oil-engine compressor shows how a Cameron 1½ SV pump is belt driven from the flywheel. The pump provides circulating water for the unit.

The discharge from the compressor goes to a small 18-inch by 6-foot receiver, and from this receiver a 3-inch air line leads to each well. Each air line is provided with a globe valve located inside the engine room so that the engineer in charge of the plant can control the output of the three wells from his station there. The starting pressure is 115 pounds gage, and the working pressure is 105 pounds. The unloader is set at 120 pounds. The POC-2 unit can pump either two or three wells simultaneously without the compressor unloading.

Cooling water is drawn through a 2-inch line, provided with a globe valve, that connects the surge tank with a settling tank of concrete. The settling tank is 9 feet long, 5 feet wide, and 5 feet deep, and is subdivided by two partitions. This tank is equipped with a drain pipe to free the tank occasionally of accumulated sand. Circulating water is handled by a Cameron 1½ SV pump, belt driven from a small pulley attached to the engine flywheel. The pump suction is connected directly to the settling tank; and as there is always a positive head on the suction it is not necessary to prime the pump to start it.

The engine runs on Diesel fuel oil of approximately 26 degrees Baumé. This oil is furnished by the Aguila Oil Company at a cost of 5½ centavos (2¾ cents) per liter (1.0567 quarts). The lubricating oil, obtained from the same source, costs 40 centavos per liter.

The POC-2 oil-engine compressor of 150 hp. that operates the three air lifts in the wells on the cotton farm at Nuevo Linares.

The air lift has proved the most economical and reliable system for pumping water in this particular district. Wherever a well is equipped with a vertical deep-well centrifugal pump, that pump is driven either by a 75-hp. electric motor or by a Diesel oil engine of from 75 to 100 hp. There are very few wells with vertical deep-well pumps that can pump more than 100 liters (26.5 gallons) per second, because the rapid wear of the runners very quickly diminishes the pumping capacity.

But one operator is required to take care of the three wells at Nuevo Linares. Owing to local conditions and the distance of nearly 2,000 feet between adjacent pumps, it is likely that three men would be needed for the three wells if some other system of pumping were employed. The oil engine-compressor unit operates at an altitude of 3,500 feet.

NOZZLES OF WATER WHEELS GIVEN LONGER LIFE

THE San Joaquin Light & Power Corporation, of Fresno, Calif., has conceived a method whereby it is possible to prevent the rapid erosion of impulse water-wheel nozzles, a maintenance problem that has always been a troublesome one in high-head plants. At the company's new Balch power house, according to the *Electrical World*, the water passing through the 7⅛-inch nozzles with a velocity of 360 feet per second under an effective head of 2,243 feet had a very decided erosive effect on the throat rings and the nozzles of the 40,000-hp., double, overhung waterwheel. In fact, the bronze or cast-steel nozzles had a life of from 35 to 40 days only, and this despite the fact that the water is clean and free from abrasive materials.

By welding "Stellite"—a very hard and tough alloy—on to the cast-steel nozzles, the cutting action of the water has been reduced to such an extent that no signs of erosion were found on the main water-wheel nozzles after two months of service nor on the exciter-wheel nozzles after six months of operation. The alloy comes in ¼-inch rods, and is welded on to the steel nozzles with an acetylene torch. After that the nozzles are put into a lathe and ground down with an emery wheel—the metal being too hard for a lathe tool. The work is done by the power company's men at a cost of approximately $75 per nozzle.

Through the substitution of powerful electrically driven dredges for the old steam dredges of small capacity, the output of platinum in the Urals bids fair to be increased measurably. The new machinery, put in service early in 1927, makes it possible to work poor deposits at a profit because of the savings effected in operating costs. In other words, it handles sands having a platinum content of one six-hundredth of an ounce per ton. Steam has not been used to advantage on sands containing less than three times as much of the precious metal.

Work on Stone Mountain Memorial Goes Forward Steadily

This Magnificent Undertaking Has Won the Cordial Support of All Sections of the Nation

By R. G. SKERRETT

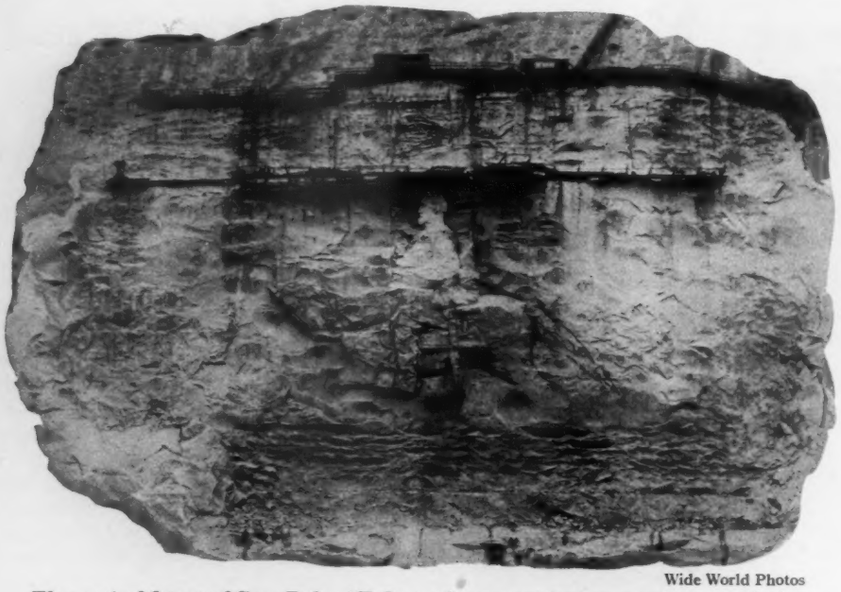
STONE Mountain Memorial, for years a sentimental project awaiting materialization, is now taking form and bears a roughly blocked, titanic figure of Gen. Robert E. Lee astride a steed of no less splendid proportions. This central figure stands forth sufficiently to give a measurable index of what the memorial in its entirety will be in the years to come when this expression of the spirit of the South has been brought to its intended fulfillment.

Lest there linger in some minds a misconception of the purpose of the memorial, let us repeat what has been said by Hollins N. Randolph, president of the Memorial Association: "Here we have a monument which shall perpetuate the glory and the splendor of human character—a monument dedicated to the highest attributes of the human spirit—a monument which shall hand down to endless generations the inspiration of the life of Robert E. Lee.

"We are not engaged at Stone Mountain in glorifying the military genius of General Lee, great and glorious as it was. We are not glorifying the military victories achieved by the soldiers who fought his battles sublime, wonderful though they were. The ideal our children shall take away from that majestic and beautiful sculpture will not be the ideal of military conquest. It will not be the ideal of physical beauty. It will not be the ideal of the splendor of kings and Pharaohs. What we are glorifying on Stone Mountain is loyalty to principle, devotion to duty, and sacrifice of self—and 'no generation of youths shall ever pass that way and be the same again, for in their hearts will burn forever the light of that ineffable symbol.'"

For years and years much was said and written urging the carving of a memorial on the face of Stone Mountain, a memorial to those men that fought and bled and suffered and died in support of the Southern Confederacy, but nothing of an organized nature was done until a frail elderly gentlewoman of the South determined to make a real start. She was Mrs. Helen Plane, the widow of a Confederate officer who abandoned his honeymoon to lead a company of Georgia volunteers, and who fell mortally wounded in the first fight in which he participated. As a result of Mrs. Plane's undaunted efforts, the Stone Mountain Confederate Memorial Association was organized in the spring of 1916. But little was accomplished, other than to

Top, left—Monument commemorating the deeding of the face of Stone Mountain to the Confederate Memorial Association. Right—The way the face of the mountain had to be cleared to provide a vertical plane for the memorial design. Bottom, left—"Leyner" sharpener and I-R oil furnace used to keep the drill steels fit for their work. Right—Sending a lot of sharpened steels aloft to the drillers.



Wide World Photos

The central figure of Gen. Robert E. Lee as it appeared when nearing completion.

arouse sympathetic public interest, until seven years later. After that the project moved forward with commendable speed—the greatest showing having been made in the last two years.

The owners of Stone Mountain—Mr. Samuel Hoyt Venable and his nieces, deeded 1,000 linear feet of the face of the mountain to the United Daughters of the Confederacy, who, in their turn, transferred the property on May 20, 1916, right to the Memorial Association.

The association has thus explained the general character of the design which is to be carved in gigantic proportions on the mountainside: "The plans for the Stone Mountain Confederate Memorial contemplate a central or reviewing group of sculpture to be carved on the north side of the mountain, an infantry group, a cavalry group, and an artillery group, which, together, will form a stupendous military panorama sweeping across the precipice a quarter of a mile or more, producing the effect of a mobilization of the armed forces of the Confederacy, an army in stone moving in lifelike procession across a mountain of stone."

The central or reviewing group, as now being carved, will be composed of equestrian statues of Jefferson Davis, Robert E. Lee, "Stonewall" Jackson, and a mounted color bearer. Later on, if funds are available, five more generals and one color bearer will be added. The design is the handiwork of Augustus Lukeman, for years associated with Daniel Chester French, the dean of American sculpture. Mr. Lukeman has to his credit many fine and important works; and, being a Virginian by birth, he is in complete harmony with the spirit of the memorial undertaking.

Stone Mountain is a towering body of gray granite standing alone in an expansive plain, and is situated about twenty miles to the north and east of Atlanta, Ga. Geographically, it is close to the center of what was once the Southern Confederacy. Stone Mountain lies nearly foursquare with the cardinal points of the compass: and it is upon the precipitous north face of this great stone body that the memorial is being carved. Stone Mountain is 8,000 feet long, 800 feet high, and two miles in diameter; and to walk around its base is a journey of seven miles. It is an interesting fact that Stone Mountain is made up of the same mass of granite that has been uncovered in excavating for the deep foundations of Atlanta's tallest buildings. Geologists have declared that Stone Mountain is older than the Rockies and the Andes, and that it was created even before the earth had an atmosphere in which vegetation could flourish.

The same experts have advanced the theory that the mountain was formed by a molten mass forced up and into the then existing earth crust, where it solidified. Afterwards the adjacent crust was worn away by erosion—the forces that had carried away the superposed and surrounding crust leaving this immense solitary body of solid stone virtually unaffected. Ground for this assumption appears in certain large and scattered rocks, of a different chemical analysis, now resting prone upon the crown of the mountain. The erosive action of the remote past is further evidenced by deeply cut pits which slope downward and outward on the top of the mountain. These pits, which have an average depth of 24 inches, all run at an angle contrary to the direction that they would follow if the erosion had been caused by the rains of thousands and thousands of years.

So well, indeed, has the mountain resisted the changes that have taken place in the course of time that competent authorities have estimated that the exposed surface probably erodes at a rate of not more than a quarter of an inch during a period of 1,000 years. The memorial association has, therefore, chosen wisely in electing to carve on this mountain an impressive tribute to the steadfastness and to the valor of the manhood of those that gave their best to the cause of the Southern Confederacy.

The grain of the granite runs perpendicular and parallel with the north face of the mountain. Accordingly, the carving will be done in the hard way of the grain and, consequently, the work will be just that much more enduring and less likely to be injured by weathering. The contract for the carving of the reviewing group of four figures was awarded to the Stone Mountain Granite Corporation. This concern operates extensive granite quarries over on another side of the mountain and is, for that reason, thoroughly familiar with the stone.

The primary problem for the contractor was to clear away a vertical plane high enough and broad enough to furnish an ample area for the sculpturing of the four mounted figures in question. In order to provide this working surface, the contractor had to remove a great wedge-shaped mass of nearly 600,000 cubic feet of rock; and this was done by starting at the top and drilling and blasting seven successive benches—the first bench containing 13,320 cubic feet of rock and the last bench 161,200 cubic feet of rock. Each cubic foot of granite weighs 165 pounds and, all told, nearly 50,000 tons of rock had to be disposed of preparatory to starting the carving of the central group.

Perhaps it will help to an understanding of the bigness of the task if we say that the cen-

Augustus Lukeman, the sculptor, spotting guiding points of the design for transfer to the face of Stone Mountain.

tral group will occupy a space 200 feet long from side to side, and that it is a distance of 130 feet from the top of Lee's head to the ground line on which his horse stands. From the high or outermost point at the top of Lee's boot to the rocky background under his horse is a matter of 16 feet. The head of each figure will take up an area of about 30 square feet. In brief, this group is unapproached in magnitude by any other sculptured group or figure—either ancient or modern.

In clearing away the rock to produce the vertical plane on which the figures are now in the process of carving, the necessary drilling of the multitude of holes was done mainly with two X-71 air-driven drifters, held by hand. Each of these holes had an average depth of 8 feet. In thus gradually working downward until a final bench 45 feet deep was formed, the contractor had to be careful to drill and to blast so as to keep the disruptive action within bounds—that is to say, he had to avoid fracturing masses of rock that, later, were needed in reproducing Lukeman's design. In this roughing-off process, the drill holes were spaced from 2 to 4 feet apart.

In blocking out the design, however, air-driven "Jackhamers" are employed to do the drilling. These machines drill a succession of closely spaced holes—the intervening bridges between the holes being afterwards broken down by a flat tool or channel bar. This procedure is what is known as "broach channeling," and produces a slot of any desired depth. In some places, excess rock is being cleared away with pop holes—holes drilled with "Jackhamers" and loaded with small charges of explosive. The finer work of modeling the principal contours is done by drilling one or more holes and by splitting off the undesired rock by the plug-and-feather method—that is, tapered steel wedges and pins are used to fracture the rock along the chosen line

The central group now being carved on the north face of Stone Mountain. From left to right, the figures are those of Jefferson Davis, Robert E. Lee, "Stonewall" Jackson, and a noncommissioned color bearer.

About 40 men are now engaged on the project. Most of the drillers have been drawn from the mining districts of Tennessee and North Carolina, and are experienced in rock work. The staging upon which the men stand to do the carving is suspended from a number of steel beams that have their inner ends anchored in recesses cut in the face of the mountain; and the outer ends of the beams are held up by 1-inch cables tied to "U" bolts that are also anchored in the face of the mountain at points above. The cables have turnbuckles where they connect with the beams so that they can be adjusted. The cables are spaced 10 feet apart. The working stage is raised and lowered, to meet operating requirements, by suitable cables attached to the beams.

Close-up of the area cleared for the carving of the memorial design. Note the vertical marks of the drills by which the excess granite was removed in seven benches or steps.

The Stone Mountain Granite Corporation started drilling on the face of the mountain on September 17, 1926; and about three weeks of preparatory work was necessary for installing the air line, staging, etc. The contractor expects to have the central group finished within two years from the date mentioned. At this writing it is planned to have the work so far advanced on April 9—the anniversary of Appomattox — that it will be possible on that day to have the official unveiling of General Lee's head and body, as well as of a considerable part of his horse "Traveler." Air for the drills is furnished by compressors housed at the base of the mountain, and the air is carried upward through 3½-inch piping to the staging.

An accompanying diagram serves to indicate the principal features bearing upon the project in relation to the spectator who views the memorial from the highway that runs parallel with the face of the mountain. The maximum angle of vision will be 45 degrees upward from the ground line; and this point of view adds somewhat to the difficulties of the sculptor, because he must compensate for this angular vision. This calls for a measure of faking to insure satisfactory perspective and to avoid unpleasant distortion. The problem can be better realized when one is reminded that the shelf or bench at the base line of the design is 175 feet above the level of the highway, and that the outer edge of the bench is 1,086 feet from the center of the road.

The group model shown by one of our illustrations is 12½ times as small as the reproduction will be; and from the model essential points of the design are transferred to the rocky face of the mountain by means of a pointing machine. The mountainside is being marked off in a series of 10-foot squares corresponding to squares on the model of reduced proportions; and these points, when transferred, serve as guides in carving the figures.

Shadow effects are being studied and worked out from quarter-size plaster models that are taken up on the staging where the carvers can refer to them frequently. In reproducing the design on any of the 10-foot squares, the carvers go from the top to the bottom and from side to side.

The memorial, in its final form, will include a memorial hall dedicated to the Women of the Southern Confederacy, whose fortitude and sacrifice inspired their soldiers on the

Wide World Photos

This close-up of the head of General Lee, taken recently, gives a good idea of the titanic proportions of the figures.

field of battle. This feature of the memorial will be an immense semicircular shrine cut into the mountain beneath the figures now being sculptured. In front of the shrine there will be constructed a large reflecting pool which will add much to the impressiveness of the memorial. All told, the undertaking will require from eight to fourteen years to bring it to completion; and the estimated cost will range somewhere between $3,000,000 and $5,000,000.

Although this splendid tribute is dedicated to the Southern Confederacy, it is, nevertheless, a memorial in which the Nation as a whole is participating and, as such, the American people can draw from it inspiration and a heartening reminder of what human aspiration held high can achieve under the leadership of men like Lee and his associates.

NEW WOOD PRESERVATIVE

THERE has recently been put on the market by the Curtin-Howe Corporation, of New York City, a new wood preservative that bears the name of zinc meta-arsenite. It is the product of Dr. L. P. Curtin, chemist of the Western Union Telegraph Company, and was developed by him primarily for the treatment of telephone and telegraph poles.

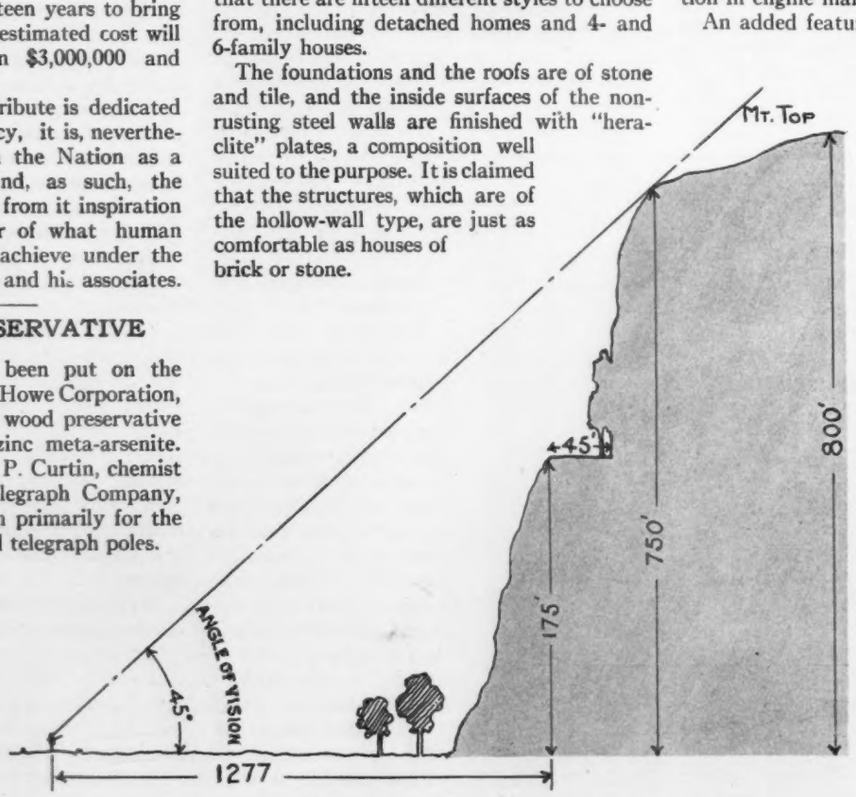
According to an official of the corporation: This preservative, in addition to its permanence, leaves the wood with the original color. The Western Union has made some thorough tests, both with lacquer and varnish, and has proved conclusively that these protective coats can be used on wood treated with zinc meta-arsenite just as successfully as on untreated wood. The cost of the preservative for treating wood on a large scale amounts to $5 per 1,000 feet.

Wood treated with zinc meta-arsenite is recommended for use in all exterior or interior work where decay is a major problem, such as is the case with poles, cross arms, building lumber, bridge material, lath, piling, ties and shingles. The preservative can be applied with profit to sash, as the cost of application per sash would be very low and the length of life would be materially increased.

FABRICATED-STEEL HOMES

DWELLINGS of fabricated, rustless steel, that can be erected complete in 24 days, are the latest thing in housebuilding in Upper Silesia, Germany, according to *Export and Import Review*. The article goes on to say that there are fifteen different styles to choose from, including detached homes and 4- and 6-family houses.

The foundations and the roofs are of stone and tile, and the inside surfaces of the non-rusting steel walls are finished with "heraclite" plates, a composition well suited to the purpose. It is claimed that the structures, which are of the hollow-wall type, are just as comfortable as houses of brick or stone.



Profile showing essential features, but not to scale, of the Stone Mountain Memorial and angle of vision of a spectator standing in the middle of the highway that runs parallel with the north side of the mountain.

STORY OF IRON TOLD BY MOVIES

THE United States Bureau of Mines, in co-operation with three large iron companies, has just produced an educational motion picture, entitled *The Story of Iron*. The film begins with mining activities in the different iron-ore districts in this country, and successively shows the movement of the raw product from the mines to the furnaces, and the treatment of the ore, including blast-furnace operations.

Copies of *The Story of Iron* are available for distribution to schools, churches, clubs, civic and business organizations, miners' local unions, scientific societies, and other similar bodies—the only charge to the exhibitor being the cost of transportation. Detailed information may be obtained from the Graphic Section, Pittsburgh Experiment Station, United States Bureau of Mines, Pittsburgh, Pa.

NATIONAL MEETING ON OIL AND GAS POWER

THE American Society of Mechanical Engineers has recently announced a National Meeting on Oil and Gas Power to be held jointly by the Oil and Gas Power Division of that society and the Pennsylvania State College on June 14, 15, and 16 at State College, Pa. The program calls for a number of sessions at which there will be discussed by prominent engineers and executives such vitally important subjects as power economics, fuel-oil specifications, research and specialization in engine manufacture, etc.

An added feature of interest at this year's meeting will be an exhibition—the first of its kind—of oil and gas engines, parts, and accessories. Exhibition space will be provided free of charge by the college, which will also furnish a limited amount of light and power for the use of the exhibitors.

The beginning of work in Montreal, Canada, on the Pulp and Paper Research Institute marks, so it is said, probably the greatest step forward in the history of that industry. The building is being erected by the Canadian Pulp and Paper Association in co-operation with the Dominion Government and McGill University.

Fine Progress on Zuider Zee Project Being Made by The Netherlands

Vast Structures Will Shut Out the North Sea and Create in the Heart of Holland 552,504 Acres of Arable Land

By S. G. ROBERTS

THE Netherlands is winning a new battle against its age-old enemy, the North Sea. And the prospective climax of this gallant and persistent contest will be the reclamation of more than half a million acres of arable land that will make the country much less dependent upon foreign foodstuffs. Not only that, but the recovered territory will add immensely to the security and the well-being of a far greater expanse of contiguous land. Thus may be summed up, in brief, the benefits that will result from the partway draining of the Zuider Zee—an undertaking duly authorized by the States General and approved by Queen Wilhelmina on June 14, 1918. This project, in one form or another, was agitated at intervals for more than half a century; but the magnitude of the task and the cost seemed too great to warrant public support despite the material gains that might confidently be counted upon.

One has only to look at a map to realize how much of the Netherlands is made up of water; and a moment's reflection would make it easy to understand how the ever-present sea gave Holland her splendid breed of mariners and such outstanding leaders of her fighting fleets as Van Tromp, Heyn, and De-Ruyter. Similarly, the continual menace of inundation to the dwellers in the lowlands taught those hardy people how to battle with storm-tossed and fickle waters by the building of dikes. By experience they learned that sand, clay, brushwood, and stone could be so arranged and reared that they would effectually hold the sea at bay under all but exceptionally severe conditions. This skill in defense reached its climax after the country had suffered grievously through successive incursions of the North Sea that ultimately led to the formation of that body of water long known as the Zuider Zee.

As geologists measure time, the Zuider Zee is young. Before 1219, the islands of Texel, Vlieland, Terschelling, etc., formed the high points of the coast line of what is now known as the Netherlands—much of the region lying back and to the south being either dry land or marshes, with the main exception of Lake Flevo. This really ancient body of water was the outlet of the River Yssel, which was then an independent stream and not an arm of the Rhine, as it is now.

In the fateful year of 1219, a succession of violent gales blew from the northwest and lashed the North Sea into unwonted fury. The waves broke upon the coast and made great breaches in the sandy bulwarks that nature had created there in the course of time. Thus were formed the islands already mentioned; and the invading sea overflowed an immense area to a depth of from 12 to 15 feet. Hundreds of towns and villages were swept away and thousands of lives lost.

Six decades later, that is, in 1282, the North Sea succeeded in penetrating to Lake Flevo; but it was not until the beginning of the fifteenth century that the shore was shattered between Enkhuizen and Stavoren—now nearly opposite one another on the Zuider Zee. When the salt waters effected that breach in 1410, they swept triumphantly southward until they scoured out for themselves a final resting place that is today outlined by the southernmost limits of the Zuider Zee.

Stavoren dates back to the early days of the Christian era; and it was a commercial center before the ocean suddenly transformed it into a seaport. On the west shore of the Zuider Zee is the ancient town of Hoorn, the home of Tasman and that other famous navigator, Schouten, who made his birthplace forever memorable by bestowing its name upon the southern tip of South America. It was at Hoorn that Admiral DeRuyter's formidable fleet was built—Hoorn then being Holland's chief naval station; but the shifting sands of the Zuider Zee have since blocked this historic port to all but craft of very moderate draft. The destructive restlessness of the Zuider Zee has been emphasized repeatedly; and only as recently as 1859 the authorities ordered the people away from Schokland—up to then a prosperous fishing village—because of its insecurity against inundation.

The present plan, in principle at least, owes its inception to the engineering acumen of Dr. Cornelis Lely, an eminent Dutch engineer, who submitted his first project in 1887 through a patriotic civilian organization known as the Zuider Zee Association; but action was deferred until 1918, and might

Left—A tree-lined canal, with flanking roadways, passing through the heart of Edam, known the world over because of its red-coated, round cheeses.
Right—In the midst of Holland's farmlands, where the windmill is both useful and ornamental.

One of the many waterways in Holland's foremost city, Amsterdam, with the picturesque Church of St. Nicholas, built about 1300, in the distance.

Where water routes and highways meet in Amsterdam. The dome in the background is on the famous St. Catherine Church, built in 1408.

have been delayed still longer. The States General was then forced to make a decision because of two circumstances: the floods of 1916 that caused damage that had not been equaled since 1825, and the pressing food shortage that had confronted the Netherlands during the latter years of the World War.

The idea of creating thousands of acres of additional farmland in the heart of the country made an irresistible appeal to the practical mind of the populace. The financial difficulties that had to be faced by the Netherlands after the war, in common with other European nations, curtailed the outlays for the Zuider Zee project; but, even so, work has gone forward steadily and without parade—as is characteristic of the Hollanders in the prosecution of all they do, no matter how big the task.

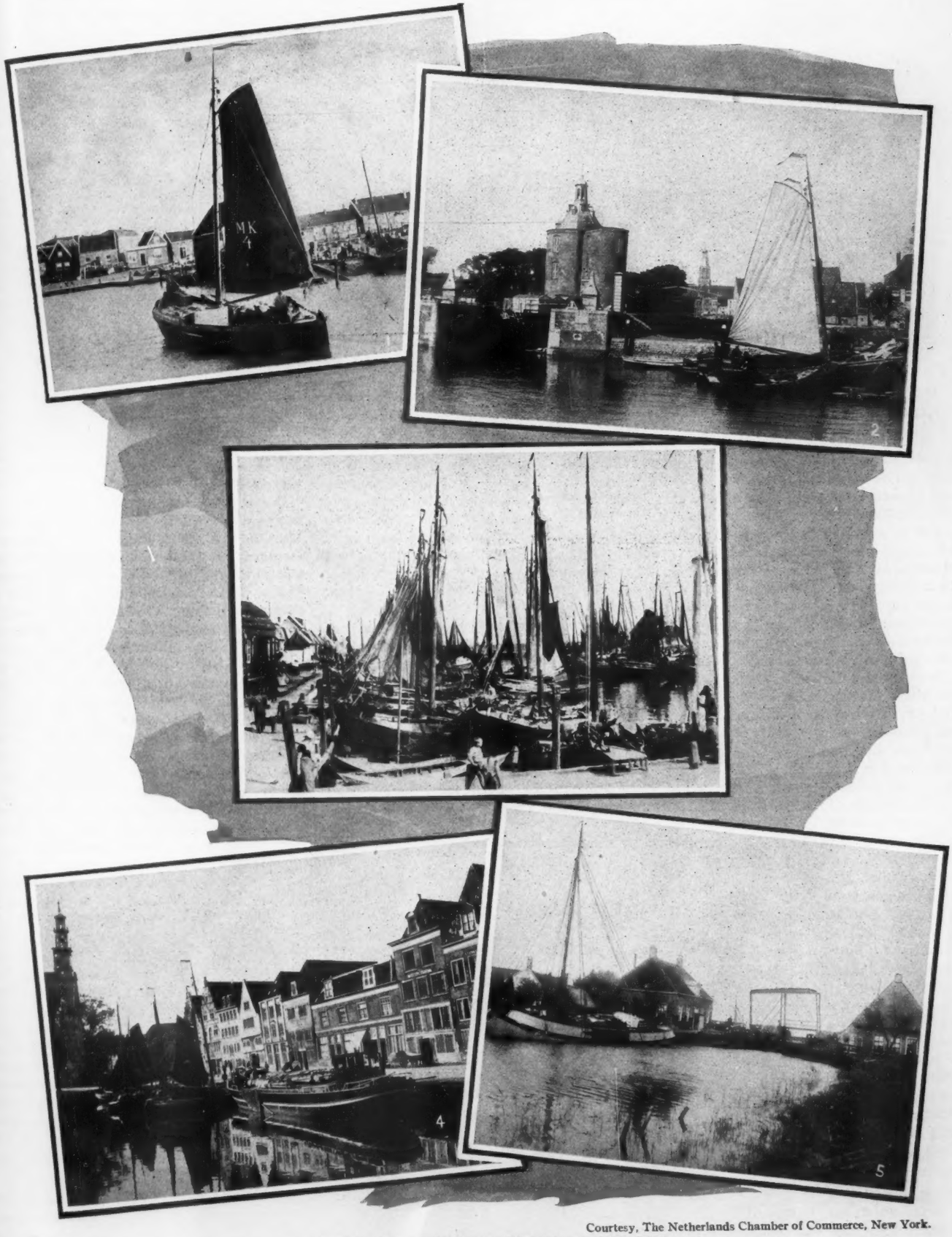
In order that we may properly evaluate what has been done, it might be well to describe, in general terms, what the undertaking as a whole involves. Nature with her limitless resources of power created the Zuider Zee; and man with comparatively puny agencies is bent upon neutralizing, in the course of two or three decades, the changes wrought by Nature over a period of centuries.

The problem of enclosing and reclaiming a considerable area of the Zuider Zee may be divided into two main divisions—namely, the construction of a monster dam or dike, 18½ miles long, that will close the gap between the Island of Wieringen on the west and the Friesland coast on the east, and then the creation of a number of polders or enclosed areas from which the sea water will be drained to provide 552,504 acres of arable land.

As a preliminary and minor phase of the entire project it has been necessary to shut out the sea from its accustomed position between the Island of Wieringen and the neighboring shore of North Holland. This work has been finished; and it necessitated the rearing of a massive dike, 1½ miles in length, which rises about 6 feet above the normal water level on the coast of the Netherlands.

The main dike will have two groups of reinforced-concrete sluices through which the excess impounded water in Yssel Lake will flow into the North Sea at low tide. All told, there will be 25 sluice gates, each 40 feet wide, affording outlets having a total breadth of

Left—Street scene on the Island of Marken, which will be absorbed in the southwest polder when the Zuider Zee is reclaimed. Right—Young girls dressed in the picturesque garb still prevailing on the Island of Marken. The rocky slope shows how the Dutch protect their coastal dikes from the erosive action of storm waves.



Courtesy, The Netherlands Chamber of Commerce, New York.

1—A bit of the waterfront of the Island of Marken.
2—The water gate of Enkhuizen with its ancient guardian tower built in the early days of the sixteenth century.
3—A fleet of fishermen in the Harbor of Spakenburg on the south coast of the Zuider Zee.
4—Hoorn, on the west coast of the Zuider Zee, has existed since the beginning of the fourteenth century, and was Holland's naval base when her fleet was in its historic prime.
5—Nykerk is near the south coast of the Zuider Zee, with which it is linked by a natural waterway.

Left—Suction dredge delivering sand in building up the dike between the Island of Wieringen and the coast of North Holland. The North Sea side of the dike is composed of boulder clay, seen rising above the water.
Right—Section of partly finished dike between Wieringen and the coast of North Holland. The picture was taken from the island end of this great bulwark.

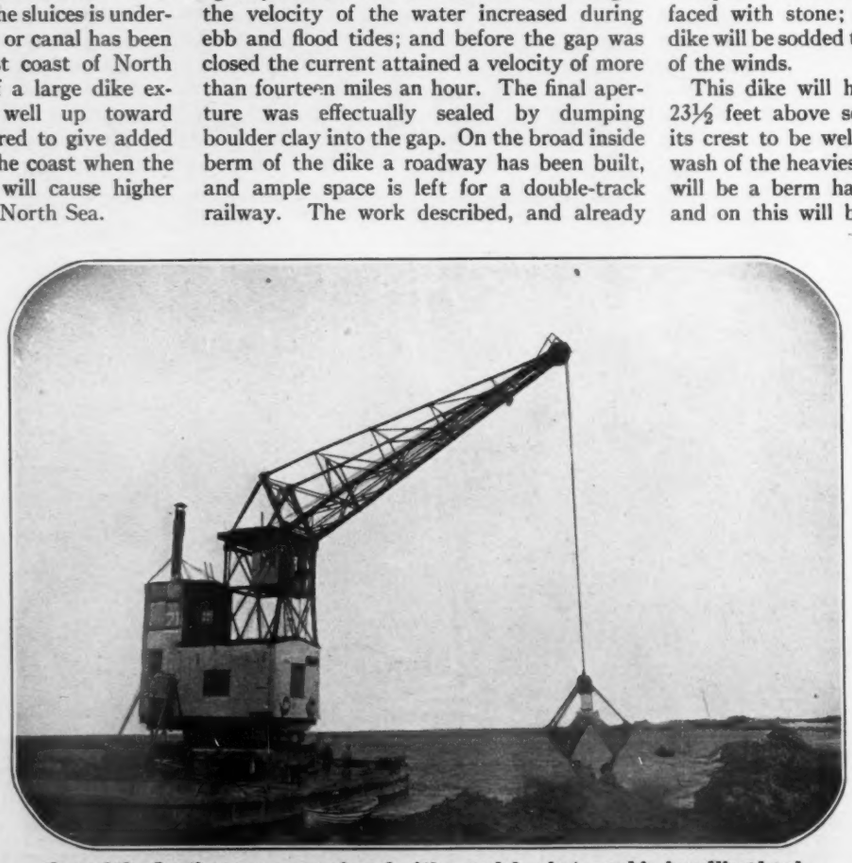
1,000 feet. Fifteen of these gates will be near the east end of the Island of Wieringen, and ten will be grouped about 2½ miles from the coast of Friesland. At the Friesland sluices there will be a lock large enough to permit the passage of vessels having a load capacity of 600 tons, and at the Wieringen sluices there will be a lock capable of admitting vessels of 2,000 tons capacity. The protecting dike or bulkhead around the area in which the sluices and the lock at Wieringen are to be built has been finished, and work on the sluices is underway. A sheltered waterway or canal has been created along the northeast coast of North Holland by the erection of a large dike extending from Wieringen well up toward Helder. This dike was reared to give added protection to that part of the coast when the sealing of the Zuider Zee will cause higher tides in that section of the North Sea.

The backbone or the main body of the dam between Wieringen and the coast of North Holland is composed of boulder clay. Boulder clay is a compact, hard soil, mixed with flints, that was produced by glacial action during an ice age; and this clay is capable of resisting, to a remarkable extent, the erosive action of waves and strong currents. In addition to this bulwark of boulder clay there is a backing of sand that is covered with a layer of ordinary clay; and both slopes of the dam above water are faced with stone. This protection against breaking seas is shown in one of our illustrations.

The striking part of this whole work is the comparatively simple mechanical agencies that have been employed in the construction of the dike. These have been a few suction dredges and floating cranes—the latter being equipped with grab buckets which have handled the boulder clay and the common clay delivered to them in barges. The sand was distributed by the suction dredges. As this dam narrowed more and more the passageway between the mainland and Wieringen the velocity of the water increased during ebb and flood tides; and before the gap was closed the current attained a velocity of more than fourteen miles an hour. The final aperture was effectually sealed by dumping boulder clay into the gap. On the broad inside berm of the dike a roadway has been built, and ample space is left for a double-track railway. The work described, and already completed, has cost in round figures substantially $8,000,000.

A cross section of the 18½-mile dike, between Wieringen and Friesland, gives a good idea of the massiveness of this defensive structure in which boulder clay, common clay, and sand will be the materials mainly used. Below water, the body of the dike will be covered with brushwood mattresses, sunk to position with stone. Above water, within the sweep of the storm waves, the slopes will be faced with stone; and above the stone the dike will be sodded to protect it from the action of the winds.

This dike will have an average height of 23½ feet above sea level—high enough for its crest to be well beyond the reach of the wash of the heaviest seas. On the inside there will be a berm having a width of 100 feet, and on this will be a roadway for ordinary traffic and two railway tracks, as already mentioned. In brief, the dam across the Zuider Zee will be a means of promoting rapid intercourse by rail or motor vehicles between the provinces of North Holland and Friesland, where the land route now is a long and roundabout one. In addition to the space for the highway and the tracks, there will be ample room for the storing of repair materials and for the laying of electric and other conduits.



One of the floating cranes, equipped with a grab bucket, used in handling boulder clay while rearing the dike between Wieringen and the mainland.

The building of the Wieringen-Friesland dike, the construction of the sluices and locks, and other outlays incident to this phase of

the undertaking will call for an expenditure, according to estimates made four years ago, totaling $36,000,000—the completion of the dike taking seven or eight years. Up to the present time, considerable work has been done on the two groups of sluices; and much headway has been made in constructing that section of the main dike, 2½ miles long, that will close the gap between the eastern sluice gates and the coast of Friesland.

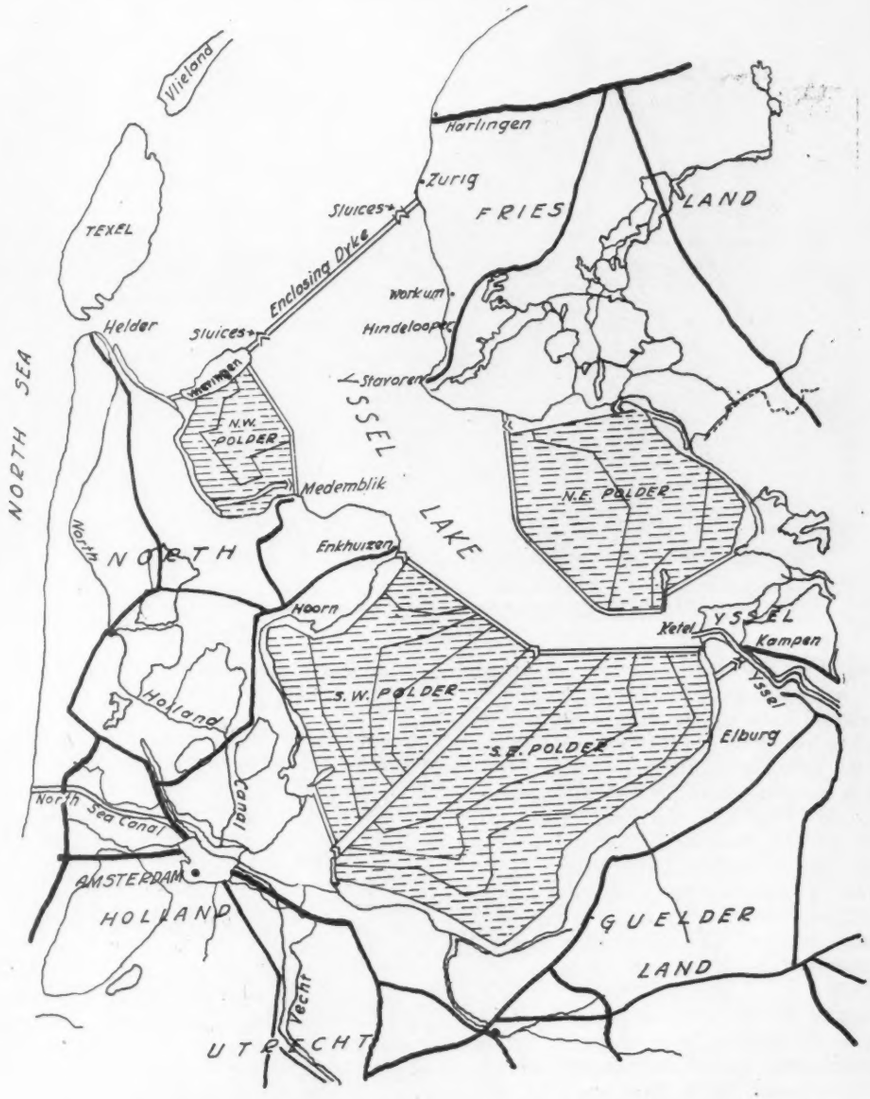
With typical thoroughness, the Netherlands authorities have constructed a small polder south of Wieringen and adjacent to the coast of North Holland. This polder has an area of 110 acres: and its object is to permit experiments to determine how soon salt can be removed and the soil made fit for agriculture. In this way, data is being obtained which will establish the length of the unproductive period in the case of each reclaimed area. This is a matter of economic importance, because the sooner the soil is in a state to produce crops the sooner money will be returned to the national treasury and the burden upon the country's taxpayers lightened proportionally. The area of this polder will be increased progressively until a total of 50,000 acres of land will be made available to the farmer.

As the accompanying map shows, the four great polders will be so built that they will not interfere with water traffic to and from existing ports on the Zuider Zee. These polders will have, as already mentioned, a total area of 552,504 acres—increasing by about 10 per cent the agricultural lands of the Netherlands. The value of the land to be reclaimed has been put at $204,000,000. There will be left of the original Zuider Zee a navigable water expanse of 247,000 acres.

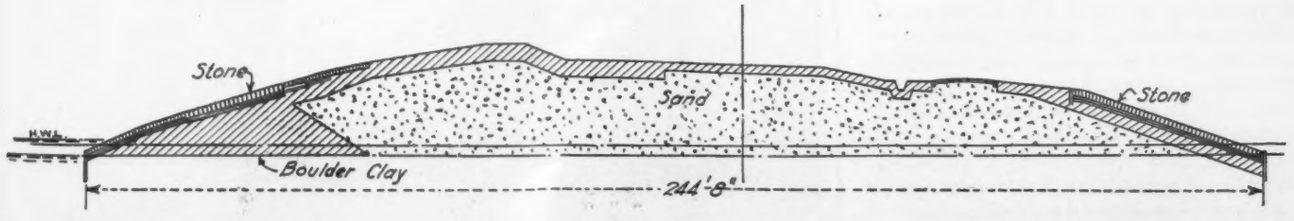
The Zuider Zee is generally a shallow body of water; and the surface of the polders, when those enclosed areas are drained, will lie at a depth ranging from 6½ to 16 feet below the mean sea level and slightly lower than the level of Yssel Lake, as the remaining body of water will be known. The average level of Yssel Lake will be maintained at 15¾ inches below the normal water level at Amsterdam. After a polder area has been enclosed by a dike or dikes, the impounded water will be removed by powerful pumps. From start to finish, the entire undertaking of shutting out the North Sea and reclaiming the polders will take 30-odd years so as not to place too heavy a monetary burden on the country; and the ultimate outlay will call for an expenditure of nearly $218,000,000.

In addition to the foregoing sum, some compensation must be made to the people now engaged in salt-water fishing within the Zuider Zee, because their industry will be destroyed when Yssel Lake becomes a body of fresh water; and it will probably be years before this lake can be stocked with fresh-water fish in sufficient quantities to revive a fishing industry there. Furthermore, military defense will have to be provided so as to protect the main dike from attack in case of hostilities.

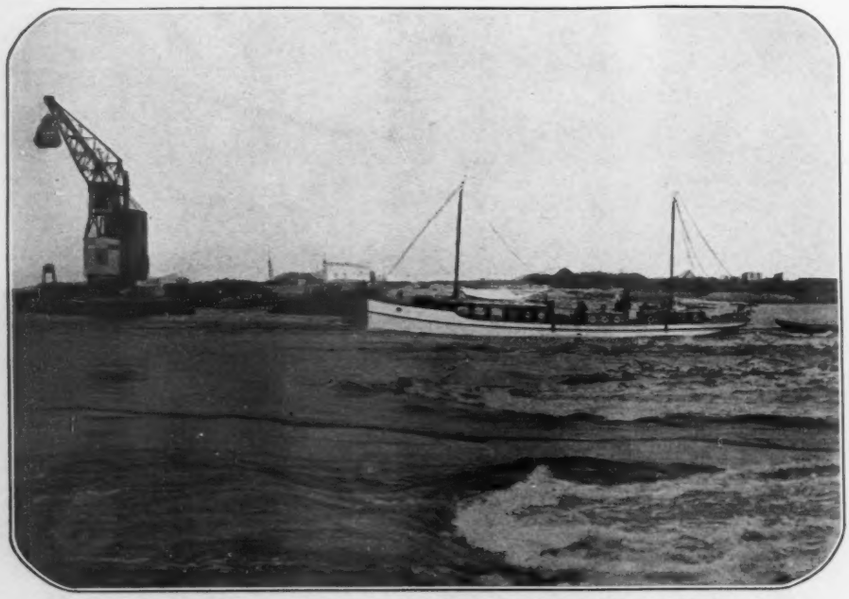
By transforming what will remain of the Zuider Zee into a fresh-water lake, the agricultural lands in that section of the Netherlands will be greatly benefited, because the farmers will be able to count upon plenty of water for irrigation as well as an abundance



Shaded areas indicate how parts of the Zuider Zee will be reclaimed and turned into farmlands. What will then remain of the Zuider Zee will be known as Yssel Lake, which will be a body of fresh water.



Cross section of the great dike that will close the 18½-mile neck of the Zuider Zee between the Island of Wieringen and the coast of Friesland. The great mass of the dike will be composed of sand, with the exposed slopes formed of highly resistant boulder clay faced with stone to withstand the action of storm waves. This dike will have a broad vehicular highway and space for two railway tracks.



Just before the dike was completed between the coast of North Holland and the Island of Wieringen the current reached a velocity of fourteen miles an hour.

of water for their cattle. Periods of drought have not infrequently compelled the drinking of brakish water by the dairy herds, and this has hurt the quality of the milk and impaired the marketability of the milk products.

The shutting out of the North Sea and the creation of Yssel Lake will make it practicable to dredge the channels deeper and to keep them clear so that shipping can move freely within the confined waters at all times and not be obliged, by reason of low water, to carry reduced cargoes. The value of the resulting benefits to shipping has been placed at $20,000,000.

Despite the fact that the ravaging sea has occasionally undone parts of the work since operations were started, still the engineers and the construction forces have stuck to their tasks with characteristic tenacity and have been uniformly victorious in the end. The whole project is a tribute to the courage of the nation, and another proof of the skill developed in the Netherlands during centuries of battling with the sea.

If the claims of Emil Keilner, of Kalamazoo, Mich., be correct, then newsprint manufacturers need no longer fear a shortage of spruce, for they will always have at their disposal an abundant supply of raw materials for the production of that commodity. It is reported that Mr. Kellner has invented a process for reclaiming old newspapers so that the stock can be reconverted without the use of any new pulp, into newsprint. The process is said to be the outcome of years of study and experimental work in both Germany and the United States.

The 1927 oil production of the western fields of Canada has shown a marked increase over that for the preceding year. A total of 329,000 barrels was brought in as against 219,000, or 110,000 more barrels.

CARBIDE FLARE LIGHT FOR MANY SERVICES

A portable acetylene flare light has been added to the line of products of the Oxweld Acetylene Company, of New York City, that is said to be extremely powerful and especially suitable wherever bright illumination is needed to carry on all sorts of outdoor operations after nightfall and certain classes of underground work, such as subway building, tunneling, etc.

According to the manufacturer, the light is extremely rugged and simple in construction—having but three parts, and these cannot be incorrectly assembled. The acetylene gas used is generated by "Carbic", and this material is made for the purpose in cylindrical cakes of uniform size. To charge the flare for twelve hours of service is a matter of but a few minutes; and the light requires no further attention until the "Carbic" is exhausted. If the lamp is extinguished before the charge has been entirely consumed, the remaining fuel can either be left in the holder or returned to the supply drum.

By means of an automatic feed, water is permitted to come in contact with the lowest cake of "Carbic" until sufficient acetylene is produced to drive the water out of the gas bell and to a point below the bottom of the cake. This process goes on intermittently while the light is burning; and gas generation is maintained at a uniform and safe pressure of less than one pound per square inch. The light is equipped with a stormproof burner, permitting its use even when the wind is extremely high; and the flare burns equally well no matter what the weather conditions. It is claimed that its operating cost per hour of service is very low.

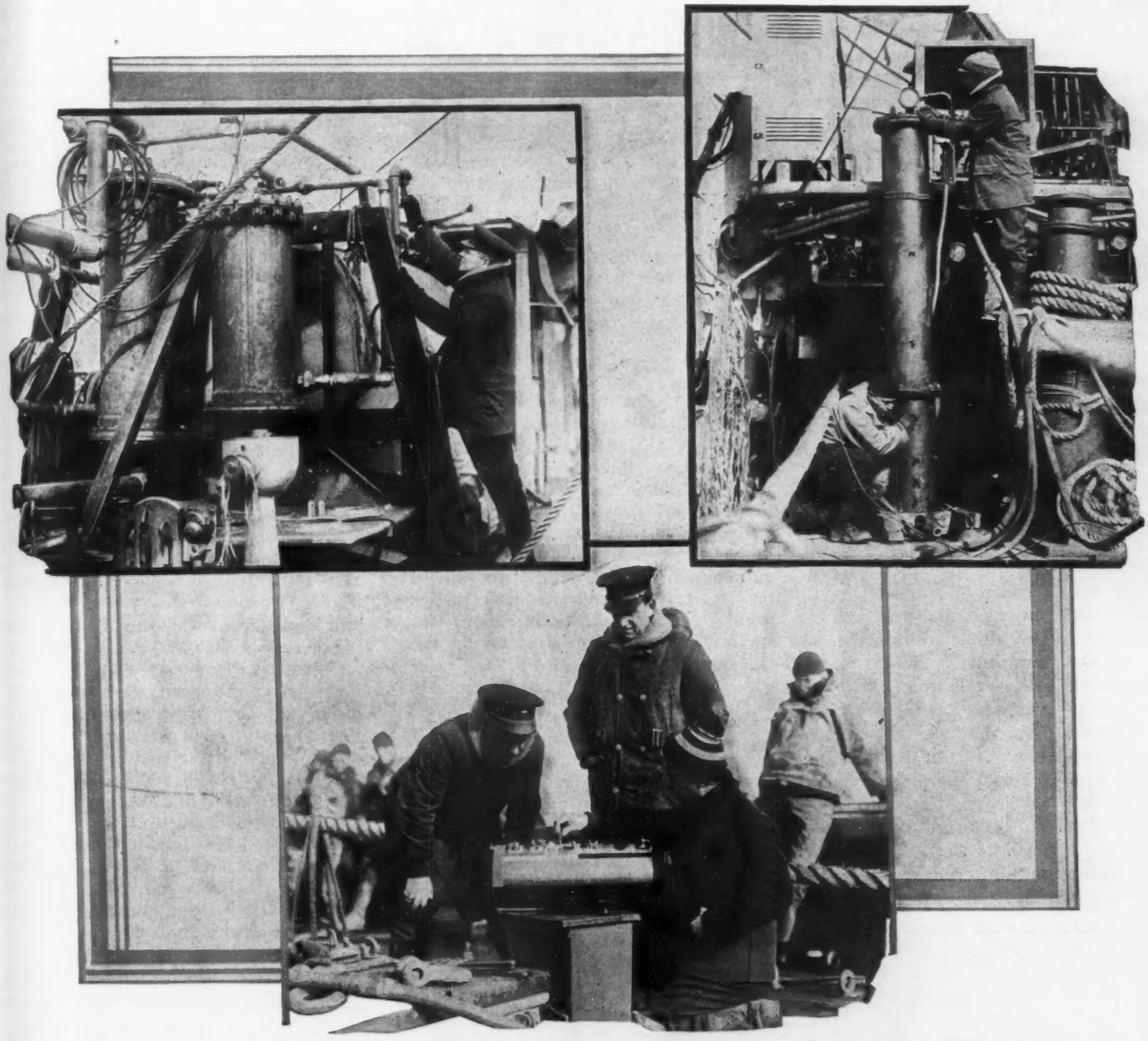
This new acetylene light is available in several styles, each of which is entirely self-contained. They range in size from a hand light to the 8,000-candle-power "Standard" model. This lamp weighs 36 pounds empty and 115 pounds charged, and stands 6 feet 7 inches high with the reflector raised. A double burner, of about the same type as the "Standard" model, is also made to give light in two directions simultaneously.

UTILIZATION OF WASTE MATERIALS

LABORATORY experiments looking towards the utilization of waste resulting from coal-mine operations have resulted in the discovery of a process whereby it is possible to convert the slaty material to be found in certain kinds of burnt-out refuse into marketable commodities. The material in question consists chiefly of calcined fire clay, and is admirably suited, so it is said in the *Mining Congress Journal*, to the making of granules for roofing shingles or for coating substances. These granules come in several shades of red and brown.

The refuse is crushed and sized before being subjected to the process. In this treatment, another heretofore useless product—the spent pickling liquor from steel-mill operations—is employed extensively.

Portable acetylene flare lights facilitate night work on construction jobs.



Left—Apparatus installed on the U. S. S. "Falcon" to dehydrate the compressed air delivered to the divers working during the winter season on the sunken submarine "S-4." The purpose of drying the air was to prevent the accumulation of frost or snow at the outlet discharging vital air into a diver's helmet.
Right—The large tube surmounted by an air gage is a form of cement gun devised for sealing the valves of the sunken submarine "S-4." The needful charges of cement were forced underwater through flexible tubing by compressed air and thus delivered to the valves to be closed.
Bottom—In order to instruct the divers how to operate certain essential valves on the deck of the "S-4", the men were made familiar with their work by the small model here shown.

DRYING GRAIN BY AID OF ELECTRICITY

THE Swedish Waterfalls Administration has been trying out a system for drying grain with electricity that, according to *The Engineer*, has given very promising results. The dehydrating equipment—the invention of a Mr. H. Edholm—consists of a fan in connection with an injector and a discharge tube, which delivers the grain on to a number of inclined boards.

In operation, the current of air from the fan gradually forces the grain up through the tube and on to the boards, where the thin layers are effectively aired. As the boards are set at an angle closely approximating the friction angle of the grain, the latter descends slowly toward the silo. The grain can thus be circulated once a day or oftener, depending on requirements.

The drying equipment has a capacity of about 8 tons; and from 2 kw. to 3 kw. of electricity is required to furnish enough heat to dry 200 pounds. Under normal conditions the moisture content of the grain is cut down to 17 or 16 per cent.

Undeveloped water-power sites in Missouri, most of which are now under consideration by private enterprise, are capable of producing an aggregate of 600,000 hp. These figures were furnished by H. A. Buehler, geologist of Missouri, after a recent survey of the waterways in that state.

ALUMINUM PAINT FOR OIL AND GAS TANKS

AS the result of investigations, conducted by the United States Bureau of Standards in our southwestern oil fields, an increasing number of gas- and oil-storage tanks and oil tank cars are being given an outer finish with aluminum paint. Paint of this description is said to possess high heat- and light-reflecting qualities.

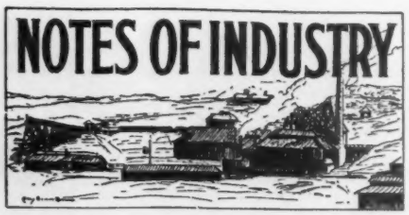
The experiments proved that the temperature of oil in tanks coated with aluminum paint was several degrees lower than the oil in tanks covered with other paint. And, besides, because of this lower temperature, the loss of highly volatile oils through evaporation was found to be less.

AIR HOIST HANDLES HEAVY SLIDING DOOR

SIMPLIFICATION is the keynote of industry today. Wherever machinery can take the place of manual labor—that is, wherever machinery can be made to bear the brunt of the burden, industry is prompt to adopt the better or easier method of doing a given job. We have a good example of this in the case of the operation of a heavy door leading from the shipping department of a large manufacturing plant on to the loading platform. The opening of this steel rolling door was effected by means of a hand hoist—the winding of the chain being a slow and toilsome task that had to be performed several times in the course of a day to permit carloads of finished products to leave the factory.

To lighten the work and to do it faster, an air-operated utility hoist is now used instead of the hand hoist; and the rolling door has been replaced by one that slides up and down. This new door is made of pinewood, is 16 feet wide and 23 feet high, and weighs about 1,250 pounds. The lifting arrangement, as shown by the accompanying picture, is extremely simple and inexpensive; and it involves nothing more than passing the cable from the hoist drum up to a pulley, then horizontally to a block over the center of the door, and down to a hook engaging the door. The main shop air line supplies the power necessary to operate the hoist. By this system, and without manual effort, the door can now be opened quickly, or in one-fifth the time formerly required.

This large door, opening upon a loaded platform, is raised and lowered by the small air-driven hoist at the left.



Since the fall of 1926, when the work of lighting the United States Government airways was started, a total of 4,500 miles has been taken care of, and 2,500 additional miles are now being provided with lights to guide air-mail pilots during the hours of darkness. The aggregate length of the present system of airways is 12,000 miles.

A total of nearly 80,000,000,000 kw.-hrs. of electricity was produced in the United States in 1927. Just what this represents in the way of energy has been strikingly brought out by the Department of the Interior in the following statement: If the current could be converted into equivalent man-power, the average American family of about four persons in this country could be provided with the services of eleven mechanical laborers working eight hours daily, including Sundays and holidays, at a total cost for the eleven of about $75 a year.

According to Government statistics, the country's annual family budget includes the following items: tobacco, $1,847,000,000; theaters, movies, and similar places of entertainment, $934,000,000; soft drinks and ice cream, $820,000,000; candy, $689,000,000; and jewelry, $453,000,000. But for electricity, to lighten housework, the yearly bill amounts to only $450,000,000, or an average of $28.30 per home in the United States.

Not long ago we made mention in these pages of the building of an ice road in Russia to facilitate logging operations. Since then word has been received that this experiment has proved satisfactory and has resulted in effecting considerable savings in time, money, and draft animals. Other similar roads are to be constructed in the forest districts adjoining the Murmansk railroads.

It is planned to establish a diamond-cutting industry in the Union of South Africa. A sum of about $100,000 has been appropriated by the Government for that purpose.

New York and Massachusetts are now the only states in the Union that do not impose a tax on gasoline.

It has just been announced by the American Road Builders' Association that the motor cars used in the United States in 1927 consumed 11,563,490,000 gallons of gasoline, an increase of 12.4 per cent over the preceding year. Assuming an average of 13.5 miles per gallon, this means that the cars covered more than 150,000,000,000 miles in the interval.

It has lately been reported by the Engineering Foundation that the large 4-dial clock and 36-bell carillon for the tower of the new library of the University of Louvain is to be dedicated with fitting ceremonies at Louvain, Belgium, on July 4 of this year. The clock and carillon are being given by the American societies of civil, mining, metallurgical, mechanical, and electrical engineers "as a memorial to the hundreds of engineers of this country who gave their lives for the defense of freedom, 1914-18." Information is being sought by the Engineering Foundation, New York City, of all such men so that their names may be recorded in the honor roll.

What is said to be the world's largest telephone switchboard is now being completed by the New York Telephone Company. It contains approximately 600,000,000 feet of wire, and will cost $200,000.

Natural gas from Pampa, in the Amarillo field in Texas, is now piped to something like 140 communities in Oklahoma, Kansas, and Missouri. This new service line has a total length of 267 miles, and was built at a cost of about $15,000,000.

The demand for liquid oxygen since it was first made in this country in 1907 has grown enormously; and there are now in the United States 150-odd oxygen-manufacturing plants, not to mention the 500 and more warehouses and distributing stations. In 1909, according to H. J. Mueller, president of the Universal Oxygen Company, the output of liquid oxygen amounted to 3,814,000 cubic feet. Sixteen years later, in 1925, it reached 2,073,826,000 cubic feet. It is an interesting fact that the cost of production within that interval was reduced from 4.7 to 1.09 cents per cubic foot.

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EDITORIALS

MOST SIGNS NOW POINT TO PROSPERITY

PESSIMISM persists in some minds regarding the outlook of business, and for these doubters we take pleasure in publishing extracts from a survey of the situation that was recently issued by the National Bank of Commerce in New York.

According to this authoritative source: "Spring expansion of business is well under way. The increase in industrial operations has been more gradual than it was in 1927 and it is quite likely that at no time during the first half year will production reach the high level it did at the end of last March. But the period of spring activity bids fair to last longer than it did last season with a large aggregate volume for the first half year.

"The pronounced change of sentiment from uncertainty and even pessimism to a definitely confident outlook which occurred during the first half of March is the result of general recognition of the intrinsically sound position of a large number of industries which have not heretofore failed to serve as accurate measures of what lies ahead.

"After giving due weight to the adverse factors in the outlook, an optimistic conclusion for the second quarter of 1928 seems definitely justified. Those industries, the interrelations of which make them both determinants and indicators of the general course of business, are in excellent condition, with prospects of a continuance of their operations at seasonally high levels until the usual midsummer lull. It seems likely that the volume of business for the first six months of 1928, considered as a whole, will be about what it was for the corresponding period of last year."

ANOTHER TRY FOR THE SOUTH POLE

ANTARCTICA, as far as most of us know, is a generally barren waste of snow and ice that is swept by violent and very frigid winds a large part of the time. And among this vast majority of limited knowledge wonderment persists that $500,000 should be subscribed to finance another expedition to the South Pole. These people ask: "Admitting that Commander RICHARD EVELYN BYRD may be able to map more of the Antarctic region than has heretofore been traversed and viewed by the explorer, what will be the gain to the world at large by such added information?" The answer to this is another question: "Why should we want to know anything about the ages gone when our problem is to live out our days in the present?"

As a matter of fact, the more we know about what happened in the eons past the more certainly and profitably can we direct our efforts in the search for essential raw materials. Not only are we thus enabled to trace the course of terrestrial changes and the progressive evolution of life in its various manifestations, but we can see clearer what may happen in the future.

A thousand years of human experience is but a fleeting moment in the total passage of time that has worked the transformations that have brought the earth to its present state. Whether or not some of the continents, now separated by far-flung oceans, were once united or much nearer to one another is a matter of absorbing scientific speculation; but it is self-evident that the majority of these vast expanses of dry land come closer to a common terrestrial focal point at the North Pole and the South Pole. The theory is held that these frigid regions once formed bridges over which animal life could pass to and fro from one to another of the great land divisions—this migration being aided by climatic conditions then prevailing. In fact, we are told that there was a time when the climate within six degrees of the Pole was no colder than it is today in New Jersey. The presence of similar fauna in certain widely separated continents is evidence that these regions were once linked by land ties; and there can be no denying that this interchange of animal life followed a course south of the equator. Furthermore, it has been established that forms of vegetation, once existing in Antarctica, are now to be found on continents that have temperate climates.

If, while mapping more of Antarctica, members of the Byrd Expedition can devote time to geological research and to the study of fossil remains of different kinds of life that may be discovered there, the contributions to human knowledge will be of the utmost value, and the vista into eons gone will be broadened proportionately. With the mechanical facilities now at Commander BYRD's disposal, thanks to engineering advance, it is to be regretted that he cannot add to those he has planned to take with him some form of portable compressor and a modest array of rock drills. Just think what such tools might do towards disclosing the story of the dim past!

FIVE MILLION MOTOR CARS

AMERICA'S automotive industry has set itself the task of manufacturing 5,000,000 cars in the course of the current year. At least, that is the goal toward which some of the leaders are working. Just what this means in the way of augmented output can be gathered from figures recently issued by the United States Government.

During the past five years the production of passenger cars has ranged from 3,631,728 in 1923 to 3,808,753 in 1925—the 1927 output of 2,938,868 automobiles being the lowest in the half decade. On the face of it, the plants must turn out this year 1,191,247 more pleasure cars than they did in 1926 in order to have 5,000,000 cars to their credit.

This may be realizable because of the degree to which standardization of tools and processes has been developed in American motor-vehicle plants. By the employment of mechanical aids of many sorts, the average man can now do high-grade work, hour in and hour out, without experiencing fatigue that is likely to lead to inefficient performance of his prescribed job. In these labor-lightening efforts compressed air is utilized widely and advantageously, and its use is increasing rapidly.

OUR EVER-SWELLING POPULATION

ACCORDING to a recent estimate by the United States Census Bureau, there will be within our gates on the first of July next a population of 120,013,000. Admitting that this figure may be subject to modification involving either an increase or a decrease, still this total of persons living in the United States will probably be found reasonably close to the fact. The Government officials, so we are informed, have based their estimate upon the best available data having to do with births, deaths, immigration, and emigration since the last Federal census was taken in 1920.

This total is an imposing one when we recall that the population of the United States in 1890 was just short of 63,000,000. In other words, despite the fact that we have erected latterly effective bars to unrestricted immigration, nevertheless our population in the course of 38 years has been nearly doubled. The significance of this is manysided, and cannot be measured in terms of mere number.

Since 1890, there have been various radical rearrangements in the fields of service of the wage earners of the nation. Fewer persons are now employed on our farms in relation to the volume of output, while a greater percentage of our people are occupied in towns and cities in producing manufactured products and in carrying on those businesses essential to populous centers. As a consequence, our foodstuffs are no longer so largely of domestic origin, and we have had to draw with each passing year more and more upon foreign sources of supply. Again, our own people cannot provide sufficient markets to keep our workshops and factories busy at anything like capacity; and to operate these

plants profitably—keeping our vast army of workers engaged the while—it is indispensable that we have just so many more buyers abroad for our commodities.

In short, while our increased population has added proportionately to our man-power and to our numerical strength, still the swelling of our numbers has brought in its train other social and economic problems; and among these is the need of greater participation in international relations and a still larger share in the give and take of world-wide commerce.

"AN APPLE A DAY"

THE foregoing line has been broadcasted in one form or another the nation over by interested apple growers as one sure means of keeping the doctor away. Most of us have looked upon this so-called slogan as an expression of sales promotion, and have been either silently or vocally skeptical of the curative or preventive virtues of the apple. The following suggestive Associated Press dispatch appeared recently in the daily papers:

"Eatontown, N. J.—For the second time within a year this village of nearly 1,000 inhabitants is without a physician. Eatontown is situated in the heart of a large apple and fruit district. The town's lone physician moved to Yonkers, N. Y., several months after his predecessor here had closed his office and moved away because of a lack of patients."

We have generally been taught that Eve ate the apple in quest of knowledge, but isn't it just likely that the monotony of the Garden of Eden called for a corrective, and that she ate the forbidden fruit in an impulsive effort to insure her physical well-being? Are not the apple eaters at this late date just following the example that Eve wisely set? What has happened at Eatontown seems to substantiate this assumption.

PAPER-MAKING IN AMERICA AN OLD INDUSTRY

THE first paper mill in America was built in Germantown, Pa., in 1690, by WILLIAM RITTENHOUSE, a Prussian by birth. RITTENHOUSE came of a paper-making family; and the product of his mill was identified with many historic activities of Colonial days.

It was not until 38 years later that New England began to produce paper at Milton; and the industry owed its start then to an act of the General Court of Massachusetts Bay Colony that gave to five men the sole privilege of making paper in that colony for a period of ten years.

Despite opposition on the part of British manufacturers, paper-making there developed steadily; and it gained a new impetus when processes were invented that made it possible to produce paper from wood pulp. Today, after 200 years, fully one-fourth of all the paper made in the United States is turned out by New England mills—the product, with an annual value of about $250,000,000, being the fruit of the labors of 40,000 workers.

ECONOMIC HISTORY OF THE UNITED STATES, by Harold Underwood Faulkner, Associate Professor of History in Smith College. An illustrated work of 301 pages, published by The Macmillan Company, New York City. Price $1.50.

THIS book is intended especially for adult readers that may not have the time or the opportunity to pursue the subject in great detail. Nevertheless, the volume should be helpful to younger students. Mr. Faulkner has dealt with our economic history in a very readable way, and has presented the outstanding features of our momentous economic development in their true perspective

AMERICAN SHIP TYPES, by A. C. Hardy. A profusely illustrated volume of 262 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $5.00.

IT is not generally realized that the northern portion of the American continent, and in particular the United States, has an important mercantile marine which is entirely domestic, and, which, from the time of the Revolution almost, has developed characteristics differing so materially from local or domestic shipping in any other part of the world that it has been judged necessary to compile a book which sets out specifically to discuss, to classify, and to clarify these characteristics. In this manner Mr. Hardy explains the reason for the present work; and he has gone to considerable pains to cover his topic in a commendably comprehensive and readable fashion. We believe this book will be found useful by many people.

THE WORLD OF ATOMS, by Arthur Haas, Professor of Physics in the University of Vienna, and translated by Horace S. Uhler, Associate Professor of Physics, Yale University. A book of 139 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $3.00.

THE volume contains ten lectures on atomic physics delivered in 1926, and is intended to present to the lay public the achievements of modern atomic physics in a brief yet reasonably thorough manner. While the aim was to deal with the subject in an easily understandable way, still it should be obvious that the subject could not be treated authoritatively and, at the same time, in a fashion that would make it as popular as a newspaper. However, the author has arrayed his topic in a manner to hold the attention of any person possessing an ordinary gift of concentration and filled with a desire to know more about the wonders of the world of atoms.

THE ROAD TO PLENTY, by William T. Foster and Waddill Catchings. A work of 231 pages, published by Houghton Mifflin Company, Boston and New York. Price, $2.00.

PROSPERITY, like the waves of the sea, has its ups and downs. There are fundamental natural forces that make the waves of the sea, and, similarly, there are fundamental causes that create the crests and the hollows of undulating prosperity. Most of us are too busy with our concerns to delve into the reasons for these fluctuations; but most of us accept the periods of plenty without question and are noisy in protest only when we have to pinch in the days of denied abundance.

Messrs. Foster and Catchings have written before on economic topics, but not before have they treated their subject as readably as they have in the present instance. In this book they point a way to a greater prosperity for business and to a wider share of the good things of life for everybody. They do this in the form of a story that is so well done that it will tempt most readers to keep right on from start to finish—learning much that will be helpful the while.

PHOTOGRAPHY, ITS PRINCIPLES AND PRACTICE, by C. B. Neblette. An illustrated volume of 644 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $6.50.

IN the preface, the author says: "Manifold as are the applications of photography in all branches of science and industry, and great as has been the increase in our knowledge of its basic principles in recent years, comprehensive and adequate instruction in the subject has been largely neglected by our universities and technical institutions. Despite its daily application to the practice of almost every branch of science and industry, and indeed in every walk of life, as well as its importance from the standpoint of pure science, there is not, within the knowledge of the writer, a single university or technical institution in this country which offers a thorough and complete course in the science and practice of photography."

Therefore, to fill this gap or to offset this lack, Mr. Neblette has produced a textbook dealing with the theory, the principles, and the practice of photography from the practical viewpoint. The book covers the historical development of photography, and then carries the reader on through all subsequent and important aspects of the subject. Unquestionably, the volume will prove of value to those that desire to qualify in the art, and will be of material aid to the photographer who wishes to add to his knowledge and to improve his performances.

Welded Piping is the title of a well-written, illustrated pamphlet recently issued by the Linde Air Products Company, New York City. A copy of this brochure can be obtained free upon application by any one interested in the subject.

Factors Involved in Economical Gas Cutting is the title of a pamphlet issued by the Air Reduction Sales Company, New York City. The pamphlet is a reprint of a paper read at the University of Minnesota some months ago.

C-E Fin Furnace is the title of a brochure issued by the Combustion Engineering Corporation, New York City. The furnace in question is described as "a water-cooled furnace which eliminates wall maintenance and increases boiler capacity." This should be of interest to power-plant engineers

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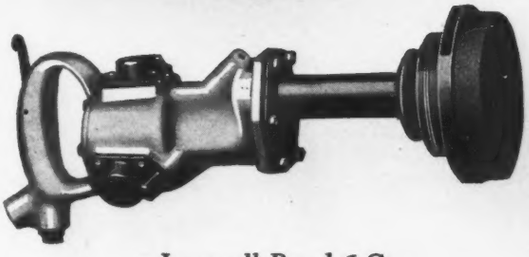

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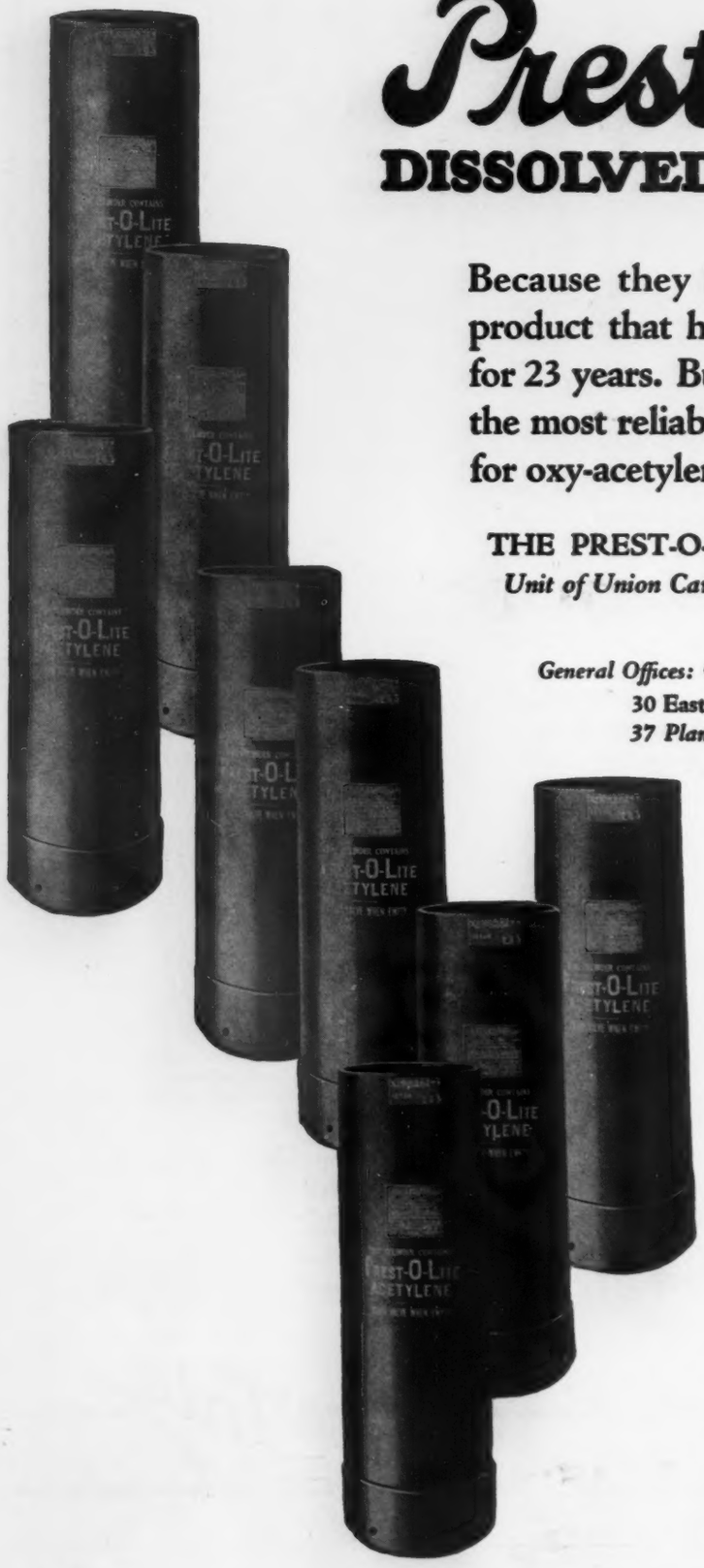

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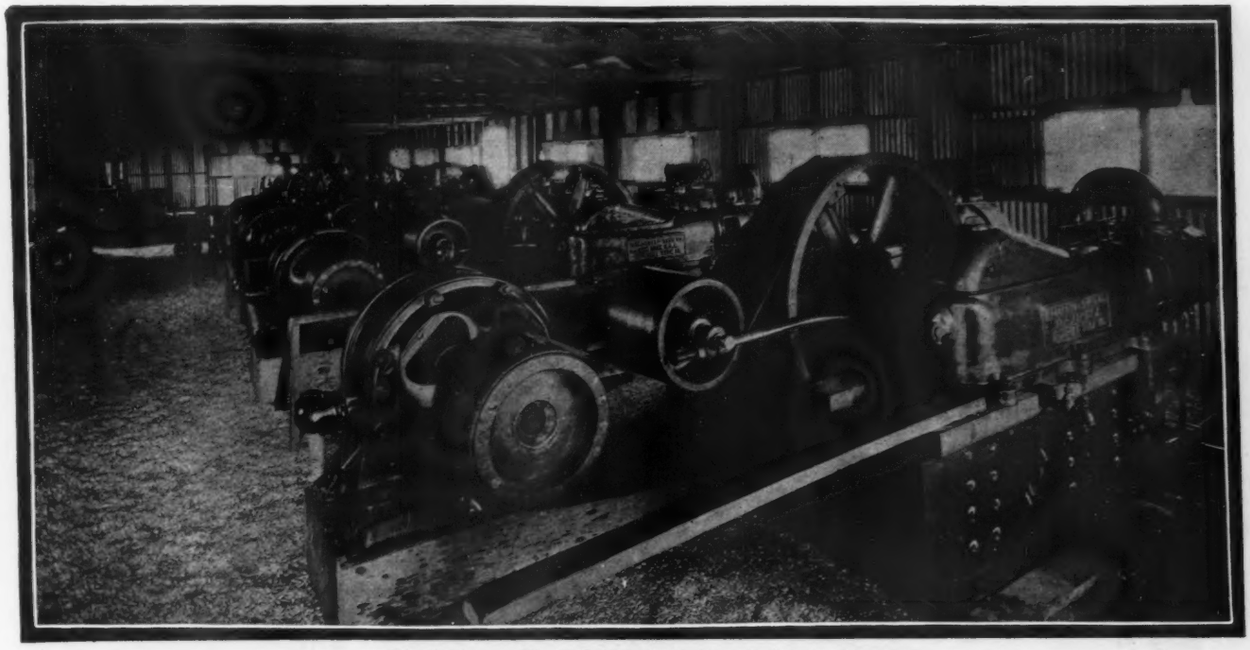

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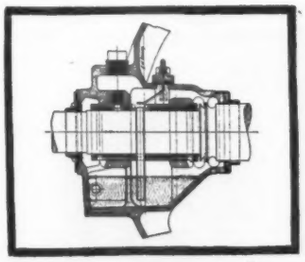

Cross section of the Sealed Sleeve bearing showing how all openings are sealed to prevent the entrance of dust and the leakage of oil. The large oil-cushioned area between shaft and bearing minimizes the damaging effects of shocks and jars.

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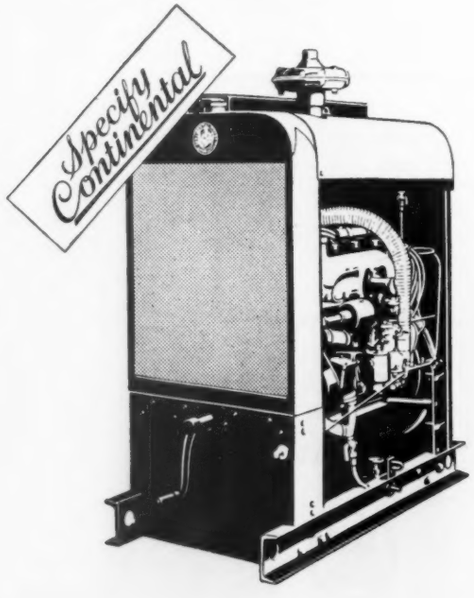

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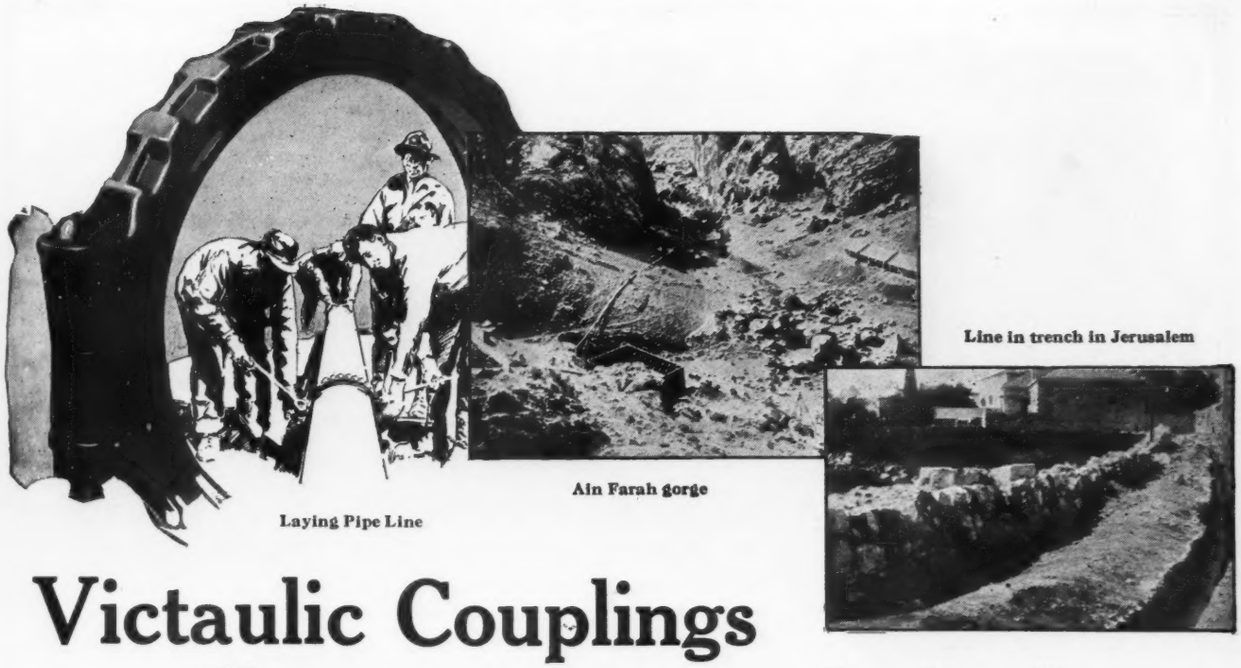

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NOTE—For subscription terms see first editorial page

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For *Resistance to Oil* . . . "COMMANDER" AIR HOSE!

"COMMANDER"
The de luxe air drill hose. Oil-proof tube; extra-heavy braided cord reinforcement; double thickness, self-armoring cover.

"TYPE 50"
Tough and strong, yet light and easily handled. For pneumatic tools and light air drill service. Oil-resisting tube; multiple braided reinforcement.

"TYPE 88"
A wrapped construction air hose built of the same high-quality materials as "Commander."

Even if you use "line oilers" to lubricate your air drills, you'll find "Commander" standing up to its work months after ordinary air hose has given out.

The inner tube is a special oil-resisting rubber compounded to withstand the action of the most malignant mineral oils, which retains its strength from two to five times as long as ordinary rubber.

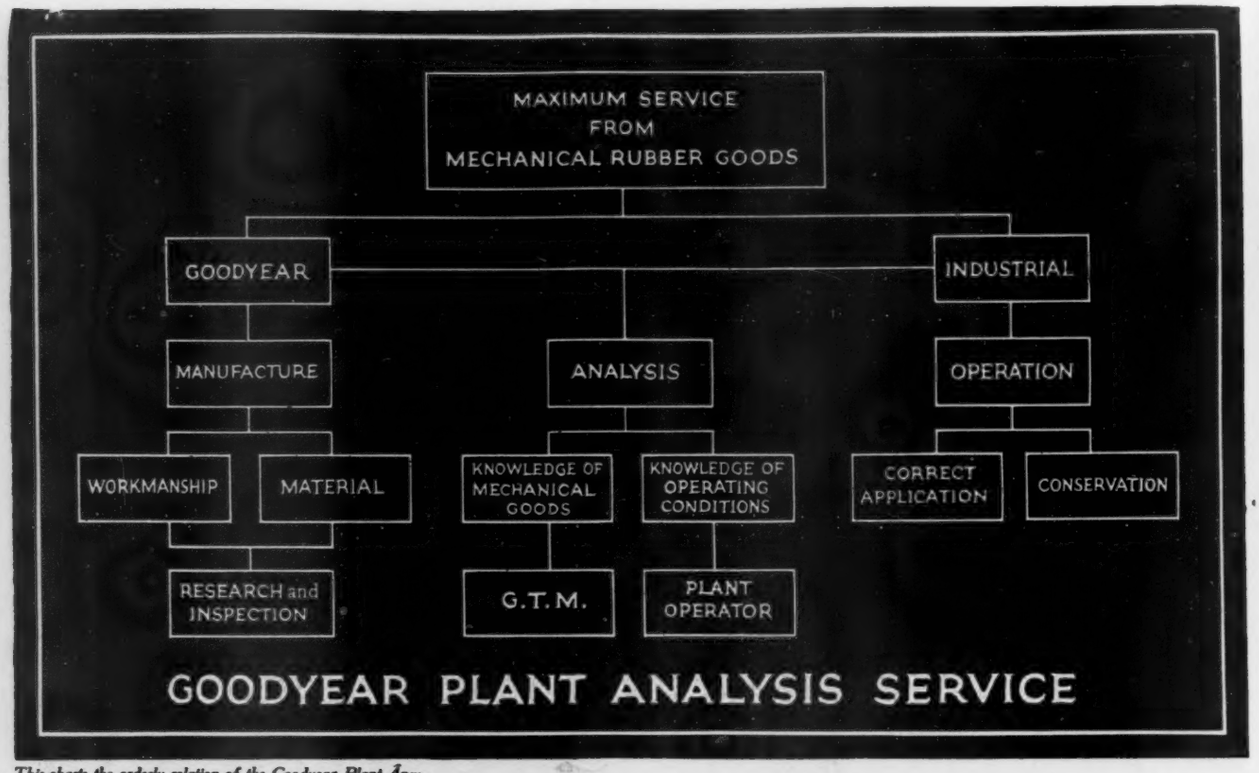
The cover is tough, brawny rubber, 50% stronger than you find on ordinary air hose —it will outwear any kind of steel armoring.

For lowest ultimate cost — Goodrich "Commander" Air Hose!

THE B. F. GOODRICH RUBBER CO.
Established 1870 Akron, Ohio

Goodrich AIR HOSE

"Type 50" "COMMANDER" "Type 88"



This charts the orderly relation of the Goodyear Plant Analysis Plan for maximum service from mechanical rubber goods

The Right Hose for Your Service

Nearly every use to which hose is put in modern industry is a use that demands a particular kind of hose, with qualities all its own.

As you very well know, quite different requirements are exacted from the hose that carries acid, for example, and the hose that carries compressed air. High pressures steadily maintained, and high pressures of pulsating character, call for different body construction in the hose. Washout hose in the paper industry must have a different tube from the tube that is wholly satisfactory for air hose. External punishment, oil in the line, the necessity for extreme flexibility—these are special requirements that must be met by special design.

The utility of a hose, therefore, depends primarily on its maker's knowledge of the working conditions which it is called on to satisfy, and the care with which you use it. The manufacturer of Goodyear Hose is concerned with both these factors, of correct construction for the duty required, and of proper use of the finished product.

The Goodyear Plant Analysis method is the means by which Goodyear helps users of hose to determine exactly what hose construction will serve them most efficiently and economically. As in the case of belting and other mechanical rubber goods, the application of this analysis plan is entrusted to the G. T. M.—Goodyear Technical Man.

The experience of Goodyear in years of careful development of Plant Analysis methods convinces us that proper analysis is exactly as important and valuable in the case of hose as in that of belts. "Just hose" is never so good nor so economical as the "right hose for the job."

The G. T. M. is an expert on hose. He is familiar with the hose requirements of many industries. In co-operation with your plant officials, he will be glad to analyze your hose problems, and help you work out a system of conservation to prolong the life of your hose.

You may depend on Goodyear Hose thus specified to your service, to give you every advantage of efficient and economical operation over a long life. For detailed information about the G. T. M., the Plant Analysis method, and the specialized hose that Goodyear makes for every line of industry, write to Goodyear, Akron, Ohio, or Los Angeles, California.

The Greatest Name in Rubber

GOODYEAR

"It nefer hass break down"

OLD John Lahm has tried all kinds of grinding machines in more than 10 years of foundry work. And for two and one-half years his Rotor Grinder has earned his wage without one break-down.

In this large southern Ohio foundry Rotor machines are used with 24% to 40% savings on production time compared with other types tried out.

And the foreman says, "Rotor Grinders give a much finer finish. We use 6″x2″ Manhattan Rubber Bonded wheels, 30-S-12-KLF."

The Rotor Air Tool Company
5905 Carnegie Avenue Cleveland, Ohio

THE ROTOR PRINCIPLE

A—Air intake port. Solid black area indicates air.

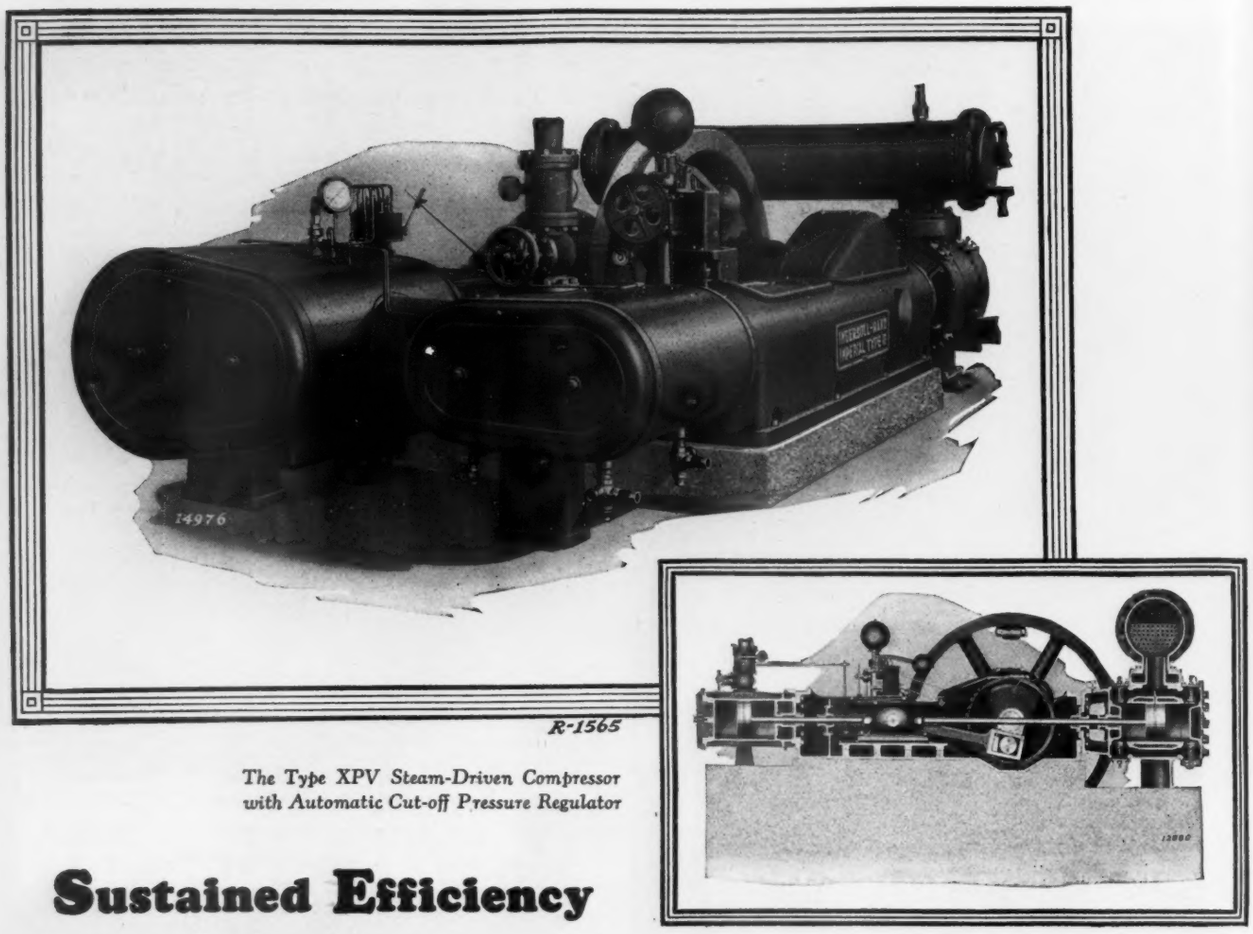
B—Fibre blade air seal. C—Rotor spindle.

D—Exhaust port. Cycle completed by one Rotor.

Ask for the Rotor Catalog

GRINDERS • BUFFERS • SANDERS • DRILLS

Rotor Air Tools



The Type XPV Steam-Driven Compressor with Automatic Cut-off Pressure Regulator

Sustained Efficiency over a Wide Range of Loads and Pressures

The Ingersoll-Rand Type XPV Steam-Driven Compressor has an exceptionally high initial efficiency, and its balanced piston valves with light compensating rings sustain this high efficiency during the normal life of the machine.

The same high efficiency is also maintained at the varying load points, since the automatic governor regulates the speed of the Compressor through the high-pressure steam cut-off.

An extremely wide load range is characteristic of the XPV machine. In addition, its discharge pressure can be regulated by simply shifting a weight on the governor lever arm. This feature makes XPV units ideal for a wide variety of air and gas applications.

Representatives of the Company are located all over the world. They will be glad to assist you with your Compressor problems.

INGERSOLL-RAND COMPANY—11 BROADWAY, NEW YORK CITY

Offices in principal cities the world over

For Canada Refer—Canadian Ingersoll-Rand Co., Limited, 10 Phillips Square, Montreal, Quebec
For Europe Refer—Ingersoll Rand Co., Limited, 165 Queen Victoria Street, London, E. C. 4

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Ingersoll-Rand

Here Is a Diesel Shovel You Can Depend Upon

The P & H 1-Yd. and 1¼-Yd. Excavators, well-known for both their high quality construction and their dependability, are now available Diesel-equipped. These motors are 4-cylinder, 4 cycle of the mechanical injection type and run on low grade fuel oil costing but a few cents per gallon. Fully developed by 4 years' research work and proven thoroughly reliable by 2 years' field use.

Gasoline Powered Excavators in
½—¾—⅞—1 and 1¼ Yd. Sizes

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Harnischfeger Corporation

Established in 1884

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New York Export Office, New York City

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Pedro Martinto, Apartado 146, Lima, Peru, and 23-25 Beaver Street, New York City (For Peru)
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Parrish & Co., Apartado No. 6, Barranquilla, Colombia.
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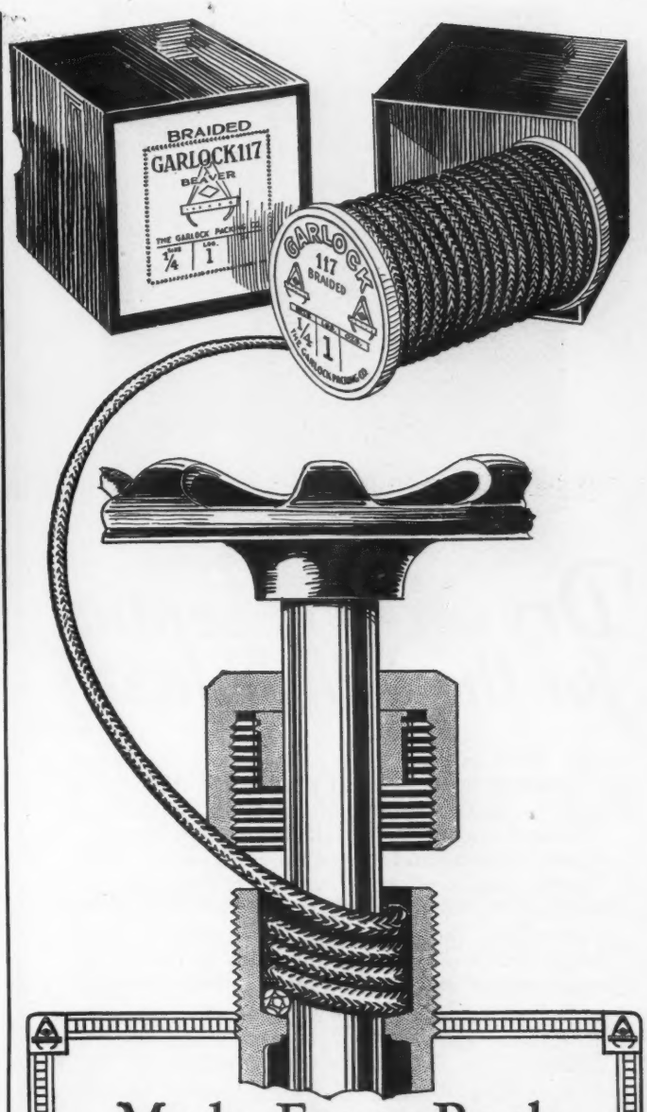
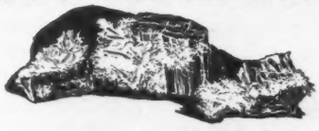


Made From Rock



Garlock Quality Controlled Valve Steam Packing is manufactured from the Crude Asbestos Rock to the Finished Product in our own Factories. We control the crushing of the fibres, the spinning of the yarns, the lubricating and the braiding and twisting, which enables us to place on the market a commodity of such quality as to warrant its membership in "The Standard Packing of the World" family.

It is a utility packing. Always keep a spool on hand for packing Valve Stems, small Piston Rods and Rotary Rods on Centrifugal Pumps.

Furnished either Braided or Twisted

THE GARLOCK PACKING COMPANY
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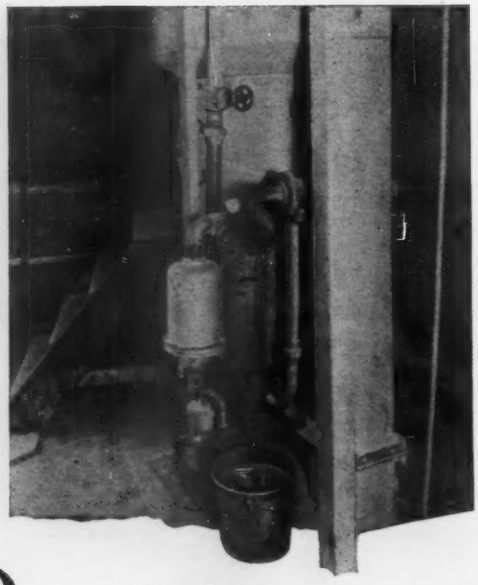
The Standard Packing of the World



Dry air is essential for the sand blast!

IF YOU are not drying the air for your sand blast you are not getting the best results possible with your equipment. Moisture in the air wets the sand and then clogs the nozzle, requiring frequent cleaning and loss of time. The wet sand, furthermore, tends to accumulate in the sand blast equipment, causing corrosion and unsatisfactory operation. When steel grit or abrasive is used, large clots are formed, which stick to the equipment and often must be removed with a chisel.

A Gast air separator will dry the air, save your equipment and speed up the work—and costs so little.

It is simple. The air passes through several layers of coarse brass screen, which strips it of all moisture and oil. These drain into a dead air chamber from which they are removed either manually or automatically with a trap.

Try a Gast separator for 30 days at our expense. You will appreciate the difference in results.

Smith-Monroe Company
1910 S. Main Street, South Bend, Indiana

"You can do it better with Gast"

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for every working condition
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Make flanges air-tight with Jenarco

Engineers who use Jenarco make pipe flanges proof against the escape of valuable compressed air. This red vulcanized rubber packing makes joints to stay.

JENARCO is also well adapted for hot and cold water and saturated steam. It doesn't crack, crumble or squeeze out.

JENARCO is available in sheet form, or in ready-cut gaskets where a number of the same size and shape is required.

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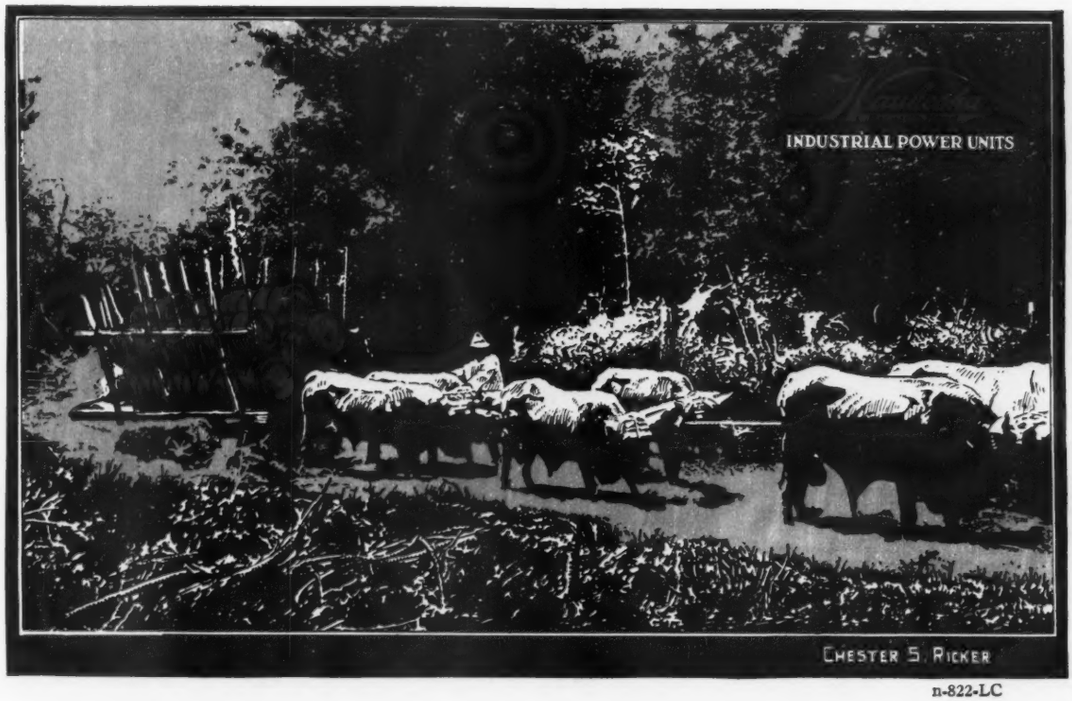

n-822-LC

To keep P & H shovels going during the rainy season in Cuba

The bull that gets there

Gasoline, because of its portability, is the only fuel that gets thru. Two Waukesha-equipped power shovels running twenty hours a day never quit on account of the daily downpour. Twenty miles of sucking mud knee deep to an overgrown giraffe separated the shovels from the railroad. But 12 head of well-fed bulls got gasoline thru and the rainy season did not hold up bulls, shovels or work.

For the tough job and the one farthest from supplies you will find experienced contractors pick Waukesha-powered machinery. They know Waukesha "Ricarao Head" engines have no equal for economy—here is a case where every gallon counts—or for reliability and power—were a break-down may mean days of expensive idleness. Waukesha Heavy-Duty Industrial Engines are used by those manufacturers most jealous of their reputation. Write for Industrial Bulletin No. 662.

N-832-LC

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